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Nov 21, 1907

A PRACTICAL GUIDEBOOK ON

EVERYDAY SURGERY

AND SURGICAL HANDICRAFT

BY

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PREFACE.

In writing this book, I have kept constantly in mind the needs of the student and general practitioner of medicine. The work is not in any sense intended for specialists and consequently diseased conditions and operations which require special skill in their management and performance have been considered briefly.

It has been my aim to treat rather fully the subjects relating to surgical pathology, surgical diseases due to specific organisms, fractures, dislocations, diseases of the bones and joints, empyema, hernia, appendicitis, amputations, and many other of the common surgical affections, while such atypical surgical conditions as tumors of the brain, and spinal cord, gangrene and abscess of the lung, surgical affections of the liver, carcinoma of the stomach and intestines and many of the more difficult surgical operations carried out in the abdomen, have received but minor consideration.

I wish in this connection, to acknowledge my indebtedness to Dr. A. L. Kästner, who has furnished me with the major portion of the drawings, and also to Dr. G. C. Ruhland who has done the proof-reading. I am pleased also, to acknowledge my obligations to Drs. J. F. McNary and H. D. Sykes for valuable assistance in procuring the photographs, and to Dr. Armin Mueller for compiling the index.

If this work meets with the needs of the student and general practitioner, I will be more than repaid for the many hours of labor it has cost.

A. Hamilton Livings.

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CHAPTER I.

BANDAGING.

Bandaging as a system may be said to be a lost art. The handkerchief bandages of M. Mayor, and the many patterns of Scultetus and Paré, have practically disappeared from the text books. The application of a bandage, however, constitutes a very important part of the surgeon's work and the student of medicine should so familiarize himself with the more important patterns as to become proficient in their application. To be able to bandage evenly, neatly, and quickly, so as to give the proper amount of support, requires judgment and extended experience.

THE USE OF BANDAGES.—Bandages are used to hold dressings in place after operations and after casualty wounds; to retain splints in position in

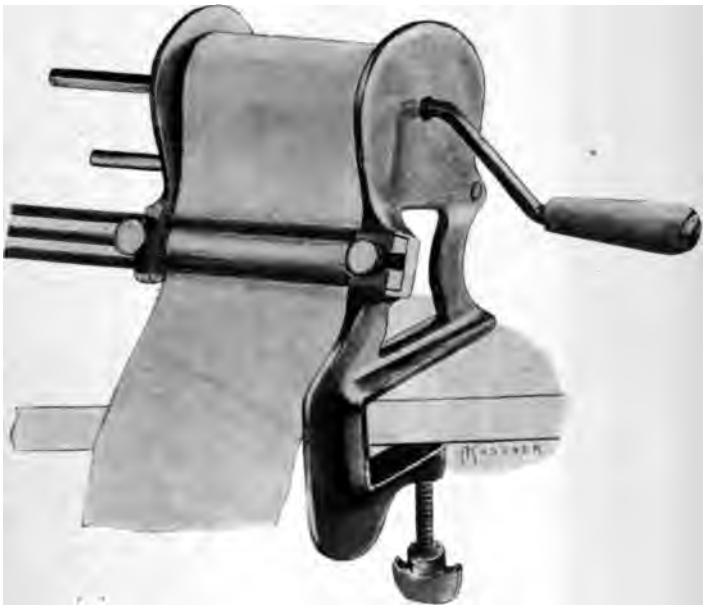


Fig. 1.—Bandage roller.

cases of fractures and dislocations; to give support to the superficial circulation; to immobilize joints; and to make compressions upon superficial organs such as the breast and testicle.

Bandages are prepared of different materials. Those most frequently

used are made of bleached or unbleached muslin, cheese-cloth, cross-ba crinoline, flannel and rubber sheeting.

THE ROLLER BANDAGE.—The roller bandage is usually made of g or muslin. This is torn or cut into strips of varying width and length. hospitals the bandages are rolled on a bandage roller (Fig. 1) while surgeon in private practice usually purchases his bandages ready to us some dealer; but the medical student should be familiar with the meth of rolling bandages by hand.

The ordinary bandage is from two to three inches in width and fi five to nine yards in length. To roll this bandage by hand, the end of strip of gauze or muslin should first be folded several times so as to fc

Fig. 2. Rolling a bandage by hand.

a small cylinder. This cylinder is then held at each end between the thumbs and first, second, and third fingers of both hands. The thumbs are placed on the top of the cylinder while the fingers of each hand cross the cylinder below the strip of bandage that is to be rolled (Fig. 2), then by alternately giving the fingers and thumb with the cylinder a half turn upwards and backwards, the bandage may be quickly and evenly rolled. The bandage should be without a selvage and rolled tightly in order to make it easier of application.

The bandage may also be rolled by hand holding the cylinder between the index finger and thumb of the left hand, while the bandage passes between the thumb and first finger, or between the first and second finger, of the right hand, then the cylinder is revolved backwards by alternately supinating and pronating the left hand, in this way the bandage may be snugly and evenly rolled (Fig. 3).

DIMENSIONS OF BANDAGES.—Bandages vary in length and width according to the part to which they are to be applied. Bandages one inch in width and three yards in length are suitable for the fingers and toes. Band-

Fig. 3.—Rolling a bandage by hand.

ages two inches in width and six yards in length are suitable for the extremities of children, and for head bandages in cases of adults. Bandages two and one-half inches in width and seven yards in length are suitable for the extremities of adults. Bandages three inches in width and nine yards in

Fig. 4.—Making the reverse

length are suitable for the thigh, groin, and breast of adults. Bandages four inches in width are suitable for the trunk.

GENERAL RULES FOR BANDAGING.—The surgeon should face his patient and be upon the right side of the part to be bandaged; the roller is held in the right hand, while the external surface of its free extremity is placed

upon the part and held by the left hand until secured by c of the strip. The bandage is then applied by carrying it from left to right, and from before backwards, each turr preceding one by about two-thirds of its width. If the par increases quite rapidly in size, as the calf of the leg, thig the bandage should be reversed at every turn, or applied figure-of-eight in order to secure an even application ar running up the limb. The reverse is made by fixing the the limb with the fingers of the left hand, as it commences anterior surface of the part, and slacking the bandage b part and roller, while the latter is given a half turn from a (Fig. 4). The reverses should be on a line in order that present the best appearance, and they should not be made inences, as the crest of the tibia, or they will be uncomfort a wrinkling of the skin.

Fig. 5.—Method of removing a bandage.

The bandage should be so applied as to meet the req case. It may be simply wound about the part in cases swelling is to be feared; or it may be quite firmly applied of making pressure, relieving swelling or securing splint position.

THE REMOVAL OF BANDAGES.—A bandage may be purpose of inspecting the part, removing stitches, changing it has become loose, or if it has fulfilled its function. Whil work upon the surgeon or his assistants, it is usually agreea to have the bandage quite frequently removed, the part bat with alcohol, the dressings renewed, and the bandage re clean operations or the setting of a simple fracture, the ba left on for a week or more, in many cases, however, they a two or three days, or perhaps once or twice a day. To re quickly and easily the folds as they are unwound should b a bunch and transferred from one hand to the other (Fig

SPECIAL BANDAGES.

OBLIQUE BANDAGES.—In the application of these bandages the turns are carried obliquely up the extremity, leaving uncovered portions of the

Fig. 6.—Oblique bandage.

skin between the turns. They may be used to advantage where the dressings have to be frequently changed and where no considerable pressure is required upon the part (Fig. 6).

Fig. 7.—Spiral bandage, ascending.

SPIRAL BANDAGES.—With these bandages the turns are carried about the part in a spiral direction, each turn overlapping the preceding one from one-half to two-thirds of its width. They are applied to parts which are

Fig. 8.—Spiral bandage, descending.

practically of the same dimensions throughout, as the arm, chest, or (Figs. 7 and 8).

THE SPIRAL REVERSED BANDAGE.—This is in very frequent use. reverses are made by giving the roller a half-turn downwards whenev bandage commences to run up the limb. The reverses should be mad

Fig. 9.—Spica bandage.

time the bandage reaches a certain point of the limb so that they wi in line, and are continued as long as the part increases in size (see Fig

SPICA BANDAGE.—When the turns of the bandage cross each oth an obtuse angle, leaving the previous turn about one-third uncovered bandage is known as a spica bandage. This bandage is especially u about the hand, shoulder, foot, and groin (Fig. 9).

Fig. 10.—Figure-of-eight bandage.

FIGURE EIGHT BANDAGE.—This bandage is so applied that its turns the form of a figure eight. The bandage is especially useful about the shoulder, elbow, knee and ankle (Fig. 10).

RECURRENT BANDAGE.—This bandage is so named in consequenc the fact that it starts from a certain fixed point, is carried to a se

fixed point and then returned to the first. It is then carried forward and backward until the desired area is covered. Each recurrence of the bandage should cover two-thirds of the preceding. The recurrences are held in place by a few circular turns about the part. This bandage is especially useful about the head and to cover stumps after amputation (Fig. 11).

Fig. 11.—Recurrent bandage for hand.

COMPOUND BANDAGES.—These bandages are composed of two or more pieces of cloth which have been sewed or pinned together. They are used to hold dressings in position in special parts of the body.

THE SINGLE T BANDAGE.—This is made of a strip of muslin, of sufficient width and length, by attaching a second piece of muslin to it at right angles (Fig 12).

THE DOUBLE T BANDAGE.—The double T bandage differs from the single T by having two perpendicular strips attached to the horizontal piece in place of one, or in having the single strip split. These bandages are especially useful in securing dressings to the perineum, chest, and abdomen (Fig. 13).

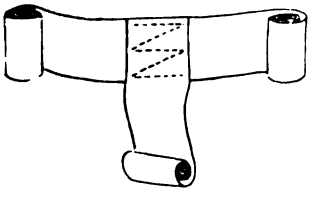


Fig. 12.

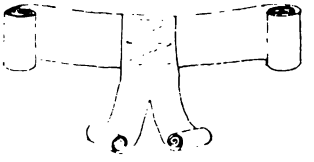


Fig. 13

MANY-TAILED BANDAGES.—These bandages are made from pieces of muslin of various widths and lengths by having their ends split into two or more pieces. A four-tailed bandage may be made for the lower jaw by taking a piece of roller bandage three or four inches in width and one yard in length and splitting its two extremities down to within two or three

inches of the center. The center is then applied to the c that passes around the chin in front is carried behind while that going beneath the jaw is carried up the sides of the ears, and tied on the top of the head. The latter from slipping over the head by securing its ends to thos passes about the neck, as in Fig. 14.

The four-tailed bandage may also be used for h place on the top of the head, as in Fig. 15.

Fig. 14.—Many-tailed bandage for lower jaw.

Fig. 15.—Four-ta top of

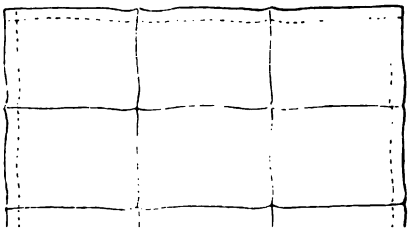


Fig. 17.—Folding a handkerchief.

Many-tailed bandages are often used for the purpose of securing dressings in place upon the chest or abdomen, by taking pieces of muslin of sufficient length and width and splitting the ends into many tails. The bandage is then passed beneath the chest or abdomen and the ends tied together in front.

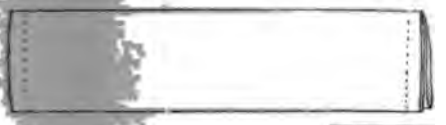


Fig. 18.—Handkerchief folded into an oblong.

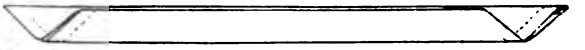


Fig. 19.—Cravat bandage.

HANDKERCHIEF BANDAGE.—A handkerchief or square piece of muslin is often used for the purpose of protecting a part or holding dressings in place (Fig. 16). The handkerchief may be so folded as to produce a number of forms, perhaps the most frequent being the triangle, which is produced by placing the diagonal ends of the handkerchief together (Fig. 17); or the square may be folded two or three times upon itself so as to produce an oblong (Fig. 18); or a triangle may be made into a cravat by turning the apex back to the base and then folding this form two or three times upon itself (Fig. 19).

Fig. 20.—Handkerchief for hand.

THE HANDKERCHIEF-TRIANGLE FOR THE HAND.—The back of the hand is laid upon the triangle so that the base of the triangle is at the wrist

and the fingers extended. The apex of the triangle is then drawn over the ends of the fingers and palm of the hand and carried back to the wrist, while the ends of the base are carried twice or more about the wrist and knotted (Fig. 20). The handkerchief is very useful for covering the hand and for preventing dressings becoming soiled.

Fig. 21.—Occipito-frontal triangle.

Occipito-Frontal Triangle.—A handkerchief from twenty to twenty-four inches square is folded into the form of a triangle. The base is placed at the occiput while the body of the handkerchief is allowed to fall over the head and the apex of the forehead. The two ends of the base are then brought around to the forehead and over the apex and knotted. The apex is then turned back over the knots and secured with a pin. This handker-

Fig. 22.—Mento-vertico-occipital cravat.

Fig. 23.—Modified mento-vertico-occipital

chief is useful for the purpose of holding dressings in head (Fig. 21).

Fig. 24.—Handkerchief for the head

MENTO-VERTICO-OCCIPITAL CRAVAT.—A square of from twenty-fc to thirty inches is folded so as to produce a cravat. The center of this then placed beneath the chin, while the extremities of the cravat are carri in front of the ears and over the top of the head, where they cross. Th are then continued down the sides of the head posteriorly and made cross at the occiput, where they are knotted (Fig. 22). In the modified ban age the ends are carried across the sides of the head to the chin in fro where they are knotted (Fig. 23). These bandages are used to hold dres ings in place in fractures of the jaw, and are also used to secure dressin in place about the lower jaw, sides of the face, top of the head or occiput.

HANDKERCHIEF COVERING FOR THE HEAD.—Turn down one corner a large handkerchief and apply this part to the forehead, allowing the boc of the handkerchief and apex to fall over the top and back of the hea

Fig. 25.—Bisaxillary handkerchief.

The ends are then carried above the ears and pinned at the occiput over the apex of the handkerchief. This makes a good covering for the head, protecting it and holding dressings in place (Fig. 24).

BISAXILLARY HANDKERCHIEF.—Fold the diagonal ends of a square so as to form a cravat. Place the center of this beneath the axilla, bring the ends up and allow them to cross at the top of the shoulder. They are then carried through the axilla to the opposite side and knotted (Fig. 25). This bandage is useful in securing dressings to the axilla and top of the shoulder.

SUSPENSORY HANDKERCHIEF FOR THE BREAST.—Take a handkerchief having a square of from twenty-four to twenty-eight inches. Fold this into a triangle and apply the base beneath the breast. Bring one end over the opposite shoulder and carry the other through the axilla, crossing the back

of the opposite shoulder, where two ends are knotted. The apex is then brought over the shoulder and pinned to a point in the back. This bandage is useful in supporting the breast and in holding dressings in position (Fig. 26).

Fig. 26.—Suspensory handkerchief for the breast.

BARTON'S BANDAGE.—Take a roller two inches in width and six yards in length, apply the end of the bandage near the mastoid and carry the roller across the back of the head beneath the occiput and then upwards behind the ear and across the center of the top of the head. The bandage is then carried downwards, in front of the ear and beneath the chin, and up the

Fig. 27.—Barton's bandage for head.

Fig. 28.—Bandage for side of the face.

other side of the face, crossing the first bandage on the top of the head. It is then carried down the side of the head, back of the ear to the point of starting. The bandage is then carried from this point around beneath the ear crossing the chin and back to the point of starting. These turns may be repeated until the roller is exhausted. This bandage is useful in temporary

dressing of a fracture of the lower jaw. It may also be used for the purpose of holding dressings in position (Fig. 27).

BANDAGE FOR THE SIDE OF THE FACE.—Take a roller two inches in width and six yards in length. The initial extremity of the bandage is applied beneath the chin and one or two turns made just behind the eye, over the top of the head and down behind the opposite ear, for the purpose of securing the bandage. Diagonal turns are then made around the head, each turn upon the affected side covering in about two-thirds of the previous bandage. These turns are continued until the entire side of the face is covered. Every alternate turn should be carried in front of the opposite ear. One or more circular turns are then made around the head at right angles to the previous turns and passing over the occiput and forehead.

Fig. 29.—Occipito-frontal recurrent bandage of the head.

Fig. 30.—Occipito-frontal recurrent bandage of the head.

Where these bandages cross over the side of the head they should be secured by one or more pins. This bandage is useful for supporting the jaw and holding dressings in place at the side of the head (Fig. 28).

OCCIPITO-FRONTAL RECURRENT BANDAGE OF THE HEAD.—Roller two inches in width and six yards in length. The bandage is secured by placing one end on the forehead and carrying the roller twice about the head, from forehead to occiput. When the roller comes back to the forehead, a right-angled turn is made and the roller is carried backwards across the top of the head to the circular bandage behind. It is then carried forward and backward, each turn overlapping two-thirds of the preceding, until one-half of the head is covered. The roller is then carried once or twice about the head for the purpose of securing the ends of the recurrent bandage; the remaining half of the head is then covered by the same method as was pursued in covering the first half. Two additional circular turns are then made

about the head, for the purpose of securing the ends of the second half of the recurrent bandage, when the bandage is fixed with pins (Figs. 29, 30 and 31).

TRANSVERSE RECURRENT BANDAGE FOR THE HEAD.—The only difference between this and the foregoing is that the bandage is carried transversely across the top of the head instead of antero-posteriorly. These

Fig. 31.—Occipito-frontal recurrent bandage of the head.

Fig. 32.—Transverse recurrent bandage for the head.

bandages are used for the purpose of securing dressings in place upon the top of the head or forehead (Fig. 32).

BANDAGE FOR THE RIGHT EYE.—Roller two inches in width and four yards in length. The bandage is fixed by carrying it twice around the head from the forehead to the occiput. It is then carried from the forehead over the left side of the head to the occiput and brought around beneath the right ear, across the cheek and over the bridge of the nose. Three or

Fig. 33.—Bandage for the right eye.

Fig. 34.—Bandage for both eyes.

four of these turns are made, each one covering about two-thirds of preceding. The bandage is then fixed in place by making two circ turns about the head. In this bandage, the ear may or may not be cov (Fig. 33).

BANDAGE FOR BOTH EYES.—Roller two inches in width and six ya in length. The bandage is fixed by carrying it twice around the head fi the forehead to the occiput. It is then carried from the occiput beneath right ear and across the cheek to the bridge of the nose and from th across the left parietal eminence to the occiput, and circularly around head. With the next turn the roller is carried over the right parietal e nence across the bridge of the nose and left cheek, and beneath the ear the occiput, and then circularly about the head. These turns are contin until the eyes are covered, those over the right eye ascending, while th over the left are descending; the intervening turns are circular. The ba age is completed by circular turns about the head. This bandage is u for holding dressings in place on the eyes (Fig. 34).

Fig. 35.—Oblique bandage for the head.

Fig. 36.—Occipito frontal bandag

OBLIQUE BANDAGE OF THE HEAD.—Roller two inches in width and s yards in length. The bandage is secured by carrying it twice about t head from forehead to occiput. From the occiput it is carried over t right parietal eminence to the forehead and then circularly around tl head. In the next turn it is carried over the left parietal eminence, fro before backwards, and then a circular turn is made around the head. The turns are repeated from above downwards, each turn overlapping one-ha to two-thirds of the preceding until the sides of the head are covered, wh the bandage is completed by a circular turn about the head (Fig. 35).

OCCIPITO-FRONTAL BANDAGE.—Roller two inches in width and fou yards in length. The bandage is fixed by a circular turn from the forehea to the occiput. The next circular turn is then made a little lower on th occiput and higher on the forehead. These turns are continued, each on overlapping the preceding two-thirds of its width. The turns upon th occiput ascend, while those upon the forehead descend. This and th foregoing bandage are used largely for holding dressings in place (Fig

Fig. 37.—Occipito facial bandage.

OCCIPITO-FACIAL BANDAGE.—Roller two inches in wi yards in length. The initial extremity of the roller is placed and the bandage secured by two turns about the head, fron occiput. A reverse is then made just in front of the ear an carried over the top of the head and beneath the chin. Tw

Fig. 38.—Gauze bandage for the neck and head.

four of these turns are made, each one covering about two-thirds of the preceding. The bandage is then fixed in place by making two circular turns about the head. In this bandage, the ear may or may not be covered (Fig. 33).

Bandage for Both Eyes.—Roller two inches in width and six yards in length. The bandage is fixed by carrying it twice around the head from the forehead to the occiput. It is then carried from the occiput beneath the right ear and across the cheek to the bridge of the nose and from there across the left parietal eminence to the occiput, and circularly around the head. With the next turn the roller is carried over the right parietal eminence across the bridge of the nose and left cheek, and beneath the ear to the occiput, and then circularly about the head. These turns are continued until the eyes are covered, those over the right eye ascending, while those over the left are descending; the intervening turns are circular. The bandage is completed by circular turns about the head. This bandage is used for holding dressings in place on the eyes (Fig. 34).

Fig. 35.—Oblique bandage for the head.

Fig. 36.—Occipito frontal bandage.

Oblique Bandage of the Head.—Roller two inches in width and six yards in length. The bandage is secured by carrying it twice about the head from forehead to occiput. From the occiput it is carried over the right parietal eminence to the forehead and then circularly around the head. In the next turn it is carried over the left parietal eminence, from before backwards, and then a circular turn is made around the head. These turns are repeated from above downwards, each turn overlapping one-half to two-thirds of the preceding until the sides of the head are covered, when the bandage is completed by a circular turn about the head (Fig. 35).

Occipito-Frontal Bandage.—Roller two inches in width and four yards in length. The bandage is fixed by a circular turn from the forehead to the occiput. The next circular turn is then made a little lower on the occiput and higher on the forehead. These turns are continued, each one overlapping the preceding two-thirds of its width. The turns upon the occiput ascend, while those upon the forehead descend. This and the foregoing bandage are used largely for holding dressings in place (Fig. 36).

ecured. This bandage is used for the purpose of securing dres-
lints on the finger (Fig. 39).

TLET BANDAGE FOR THE HAND, THUMB, AND FINGERS.—Roller
n width and three yards in length. The bandage is fixed at the
ne or two circular turns. It is then carried down the dorsum of
and over its tip and back upon the palmar surface to the first
ular turns are then made about the thumb, until the metacarpo-
l joint is reached, when the bandage is carried across the back of
and a circular turn made about the wrist. The bandage is then
own the dorsum of the index finger and this and the remaining

Fig. 40.—Gauntlet bandage for the hand, thumb and fingers.

overed in the same manner as the thumb. The bandage is com-
a circular turn around the wrist and hand. This bandage is
useful in holding dressings in place as in case of burns of the
g. 40).

-GAUNTLET BANDAGE FOR THE HAND AND WRIST.—Roller one
idth and four yards in length. The bandage is fixed by two cir-
s about the wrist, passing over the radial to the ulnar side. It
arried obliquely across the back of the hand to the base of the
er, around which one turn is made, and then back to the wrist
circular turn is given. The bandage is continued in this manner
base of each of the fingers and thumb is included. It is then
l by carrying the roller across the back of the hand, and between
b and index fingers, and then back to the wrist where a circular

and the bandage secured by a pin. This bandage is used for
of retaining dressings on the palmar or dorsal surfaces of the
41).

these turns are made, when the bandage is reversed and carried once al the head, from forehead to occiput. It is then secured with a pin. few pins should also be placed where the reverses are made. The banc is used to secure dressings to the top, back and front of the head, to temporal region and chin (Fig. 37).

GAUZE BANDAGE FOR THE NECK AND HEAD.—Bandage two and c half inches in width and six yards in length. The bandage is fixed carrying it twice about the neck. The roller is then carried from left right, across the back of the neck and above the right ear, around the fc head and back above the left ear and then twice around the neck. 1 bandage is continued with these alternating turns until the entire neck covered in and the dressings sufficiently supported.

Fig. 30.- Spiral bandage of the finger.

This bandage is used for the purpose of holding dressings in place after operations upon the neck. Its special recommendation is that the turns about the head prevent the bandage from slipping down and leaving the upper portion of the neck uncovered (Fig. 38).

BANDAGES OF THE UPPER EXTREMITY—SPIRAL BANDAGE OF THE FINGER.—Roller one inch in width and one and one-half yards in length. The bandage is secured by two turns about the wrist. It is then carried obliquely across the back of the hand and along the dorsal surface, and over the end of the finger and back upon its palmar surface for about an inch. Circular turns are then made about the end of the finger and are followed by spiral or spiral-reversed turns until the metacarpo-phalangeal joint is reached, when the roller is carried again across the back of the hand and one or two circular turns are made about the wrist and the end of the

bandage secured. This bandage is used for the purpose of securing dressings or splints on the finger (Fig. 39).

GAUNTLET BANDAGE FOR THE HAND, THUMB, AND FINGERS.—Roller one inch in width and three yards in length. The bandage is fixed at the wrist by one or two circular turns. It is then carried down the dorsum of the thumb and over its tip and back upon the palmar surface to the first joint, circular turns are then made about the thumb, until the metacarpo-phalangeal joint is reached, when the bandage is carried across the back of the hand and a circular turn made about the wrist. The bandage is then carried down the dorsum of the index finger and this and the remaining

Fig. 40.—Gauntlet bandage for the hand, thumb and fingers.

fingers covered in the same manner as the thumb. The bandage is completed by a circular turn around the wrist and hand. This bandage is especially useful in holding dressings in place as in case of burns of the hand (Fig. 40).

DEMI-GAUNTLET BANDAGE FOR THE HAND AND WRIST.—Roller one inch in width and four yards in length. The bandage is fixed by two circular turns about the wrist, passing over the radial to the ulnar side. It is then carried obliquely across the back of the hand to the base of the little finger, around which one turn is made, and then back to the wrist where a circular turn is given. The bandage is continued in this manner until the base of each of the fingers and thumb is included. It is then completed by carrying the roller across the back of the hand, and between the thumb and index fingers, and then back to the wrist where a circular turn is made and the bandage secured by a pin. This bandage is used for the purpose of retaining dressings on the palmar or dorsal surfaces of the hand (Fig. 41).

Spica Bandage of the Thumb.—Roller one inch in width and three yards in length. The bandage is fixed by two circular turns about the wrist. It is then carried along the dorsum to the thumb, over its tip and back on the palmar surface to the first joint, when one or two circular turns are made about the end of the thumb. The bandage is then carried across the back of the hand and a circular turn is made about the wrist. Figure-of-eight turns are then made about the thumb and wrist, each turn about the thumb covering in two-thirds of the preceding one, while the figure-of-eight turns alternate with the circular about the wrist. These turns are continued until the thumb and metacarpal region are covered in. The bandage is then completed by a circular turn about the wrist. This bandage is used to secure splints or dressings to the back of the hand and thumb (Fig. 42).

Fig. 41.—Demi-gauntlet for the hand and wrist.

Fig. 42.—Spica bandage of the thumb.

Spiral Reversed Bandage of the Upper Extremity.—Roller two and one-half inches in width and seven yards in length. The bandage is secured by two circular turns about the wrist. It is then carried across the back of the hand to the last phalangeal joint where two circular turns are made about the fingers. The hand is covered by ascending spiral or spiral-reversed turns until the base of the thumb is reached, when two figure-of-eight turns are made about the thumb and wrist. The bandage is then carried up the forearm and arm by spiral or spiral-reversed turns until the shoulder is reached, when two figure-of-eight turns are made about the chest and shoulder. The bandage is then secured by a circular turn about the shoulder. This bandage is used for the purpose of holding dressings or splints in position on the arm and forearm (Fig. 43).

Fig. 43.—Spiral reversed bandage of the upper extre

FIGURE-OF-EIGHT BANDAGE OF THE ELBOW.—Roller width and four yards in length. The bandage is fixed by t about the forearm, the elbow being slightly flexed. The r ried across the bend of the elbow to the forearm, where a made. The roller is then carried back across the bend of arm and a circular turn made to cover in two-thirds of tl These turns are repeated, those on the forearm ascending

the arm descend until the joint is reached. This is then covered in by one or two circular turns and the bandage secured by a pin (Fig. 44). This bandage may also be applied by making the first circular turns about the elbow, when the figure-of-eight turns are made about the arm and forearm, those on the arm ascending while those on the forearm descend. These bandages are used to hold dressings in place about the elbow and are often employed as part of the spiral or spiral-reversed bandage of the upper extremity (Fig. 45).

Fig. 44.—Figure-of-eight bandage of the elbow.

Fig. 45.—Figure-of-eight bandage of the elbow.

Spica Bandage of the Shoulder, Ascending.—Roller two and one-half inches in width and seven yards in length. Right shoulder. The bandage is fixed by two turns about the arm just below the axillary folds. It is then carried across the front of the chest and beneath the left arm, across the back to the point of starting upon the arm, and then about the arm, from behind forwards, and then across the front of the chest. Each turn should cross the previous one upon the outer side of the arm. These turns are continued until the entire shoulder is covered in (Fig. 46).

Fig. 46.—Spica bandage of the shoulder, ascending.

Spica Bandage of the Right Shoulder, Descending.—Roller two and one-half inches in width and seven yards in length. The roller is carried from before backwards beneath the axilla and across the top of the shoulder and over the chest at the base of the neck and through the left axilla. It is then brought across the back to the top of the shoulder where it crosses the first bandage. This completes the first turn and these turns are continued until the entire shoulder is covered in from above downwards, each turn overlapping two-thirds of the previous one. The bandage is then fixed by a circular turn about the arm, the end being secured by a pin. These

Fig. 47.—Spica bandage of the shoulder, descending.

spica bandages for the shoulder are used for the purpose of retaining dressings in position in the axilla or upon the top of the shoulder (Fig. 47).

Figure-of-Eight Bandage for the Neck and Right Axilla.—Roller two inches in width and five yards in length. The bandage is secured by two circular turns about the neck. The roller is then carried from behind the neck across the front of the shoulder and through the right axilla. From here it is brought over the top of the shoulder from behind forwards and again carried about the neck. These turns are continued until the shoulder, axilla and neck are covered, when the bandage is secured by a

This bandage may be used for securing dressings in position on t
: and shoulder and in the axilla (Fig. 48).

VELPEAU'S BANDAGE.—Velpeau's bandage as applied to the right sho
and arm. Two rollers two and one-half inches in width and seven yar

Fig. 48.—Figure-of-eight bandage for the neck and right axilla.

ength. The patient's right hand is placed over the top of the oppos
ılder. The bandage is fixed by placing its extremity in the left axi
n the roller is carried across the back and over the apex of the rig
ılder and down the outer side of the arm and beneath the elbow a

across the chest, and through the left axilla to the point of starting. The roller is now carried across the back and around the right side of the chest and across the point of the right elbow in a circular manner to the back. From this point the roller is carried to the top of the right shoulder, down the outer surface of the arm, beneath the elbow and to the left axilla. These turns are continued, those over the top of the shoulder alternating with the circular turns about the elbow and arm until the neck and axilla are

Fig. 49.—Velpeau's bandage.

reached, when the bandage is secured by a pin. Each turn should cover in two-thirds of the preceding. The turns from the elbow ascend to the axilla and those from the point of the shoulder ascend to the neck. This bandage is employed to fix the arm and forearm in dislocation at the shoulder, and in fractures of the clavicle or scapula. It is also used for the purpose of securing dressings in place to the arm, forearm, and side of the chest (Fig. 49).

Desault's Bandage.—Three rollers, two and one-half inches in width and seven yards in length. These are known as the first, second, and third

bandages. In securing the right arm, a wedge-shaped pad placed in the right axilla and the arm carried away from th first bandage is secured by carrying it twice around the low the chest and beneath the arms. It is then made to ascend spiral turns. Each turn covering in two-thirds of the precedi the pad in the axilla is reached and covered. The bandage is diagonally across the front of the chest, over the top of the l

Fig. 50.—Desault's bandage—first roller.

through the left axilla, across the top of the shoulder again about the chest, where it is secured (Fig. 50).

The second roller is used to bring the right arm down aga with the forearm flexed at a right angle and carried across the of the chest. The initial extremity of the second roller is placed left axilla and the bandage carried twice about the chest and o The bandage is then continued by spiral descending turns unti of the left side is reached, when the bandage is secured by a pir

The initial extremity of the third roller is placed in the left axilla and the roller carried obliquely across the front of the chest and over the right shoulder, and then down the back of the arm and beneath and across the elbow to the left axilla. The bandage is then carried across the back to the top of the right shoulder and down the front of the arm and across the forearm near the elbow. It is then carried across the back to the left axilla, or point of starting. Two or three of these turns are made so as

Fig. 51.—Desault's bandage—second roller.

to firmly secure the elbow, when the extremity of the bandage is fixed with a pin. The forearm is supported in a sling. This bandage has been used in the treatment of fractures of the clavicle and in securing the arm to the side of the chest (Fig. 52).

Arm and Chest Bandages.—Roller two and one-half inches in width and seven yards in length. Before applying the bandage a towel, piece of gauze, or thin layer of cotton should be placed between the arm and chest for the purpose of absorbing the moisture and preventing the skin from be-

coming excoriated. The bandage is fixed by carrying the around the chest and arm in a line with the elbow. The chest then covered by ascending spiral turns until the shoulder is re roller is then carried through the axilla of the sound side across t top of the shoulder to the injured side, down the front of the elbow, where it is carried between the elbow and chest and then of the arm to the top of the shoulder of the injured side. The

Fig. 52.—Desault's bandage—third roller.

then carried obliquely across the front of the chest and secured This bandage is used for the purpose of securing the arm and case of fracture of the humerus (Fig. 53).

BANDAGE OF THE CHEST.—Roller three inches in width an in length. The bandage is fixed by carrying the roller twic lower part of the chest. It is then made to cover the chest b spiral turns until the axillary folds are reached. The roller

ried through the axilla and over the opposite shoulder and obliquely down the front of the chest, where it is secured by a pin. This bandage is used for the purpose of holding dressings in place and in treatment of fractures of the ribs (Fig. 54).

FIGURE-OF-EIGHT BANDAGE FOR THE SHOULDER.—Roller two and one-half inches in width and seven yards in length. The initial extremity of

Fig. 53.—Arm and chest bandage.

the bandage is fixed into the axilla of the left side. The roller is then carried across the back of the base of the neck to the opposite side, and passed around the front of the shoulder through the right axilla, across the back of the base of the neck to the left side, and around the front of the left shoulder and through the left axilla to the point of starting. Three or four of these turns are made, each one covering in two-thirds of the preceding turn, when the bandage is secured by a pin. This bandage is especially

Fig. 54. Bandage of the chest

Fig. 55. Figure of eight bandage for the shoulder

made use of to fix and draw the shoulders backward in case of a fracture of the clavicle (Fig. 55).

GAUZE SUSPENSORY AND COMPRESSOR BANDAGE OF THE BREASTS.—For this purpose a piece of gauze ten yards in length and one yard in width

Fig. 56.—Gauze suspensory and compressor bandage of the breasts.

Fig. 57.—Suspensory and compressor bandage of the right breast.

is required. The gauze is twice folded lengthwise and rolled into a bandage. Fix the end of the bandage on the right of the right breast and carry the bandage twice over the right breast and around the body to the point of starting. Then over the right breast and left shoulder, and under the

Fig. 58.—Suspensory and compressor bandage for both breasts.

right arm and across the chest in front, and under the left arm and over the right shoulder, across the chest from right to left, covering the left breast. The bandage is then carried around the body behind where it is fixed. This is an excellent bandage for the breast when it is desired to make a compression, or for holding dressings in place (Fig. 56).

Suspensory and Compressor Bandage of the Right Breast.—Roller two and one-half inches in width and seven yards in length. The bandage is fixed by carrying it twice around the chest just below the breast. It is then carried upward over the lower and internal border of the right breast and across the opposite shoulder and brought obliquely across the back to the lower border of the right breast, which it is made to cover. It is then carried in a circular manner about the chest and brought back to the right breast and carried over the left shoulder. These turns are made alternately, each turn overlapping two-thirds of the preceding until the entire breast is covered. The bandage is then secured by a pin (Fig. 57).

Fig. 59.—Abdominal binder.

Suspensory and Compressor Bandage for Both Breasts.—Two rollers, two and one-half inches in width and seven yards in length. The bandage is fixed by carrying the roller, from right to left, twice about the lower portion of the chest. It is then carried over the lower and internal border of the right breast and across the left shoulder and conducted obliquely across the back, to the lower border of the right breast, which it covers. It is then carried across the chest and lower border of the left breast, and obliquely across the back to the right shoulder which it crosses. It is then brought obliquely across the front of the chest, from right to left, covering a portion of the left

breast. It is then continued about the body to the lower part of the right breast, and from there carried over the left shoulder and obliquely across the back, from left to right, to the right breast and across this and the left breast, and obliquely across the back to the right shoulder. The bandage is from here again carried across the left breast and around the back to the right breast. These turns are continued, each one over-lapping the preceding by two-thirds of its width, until both breasts are covered. Those over the right breast are from below upwards while those over the left breast are from above downwards. These suspensory and compressor bandages are used for making compressions, giving support and holding dressings in place (Fig. 58).

Fig. 60.—Spica bandage of the right groin, ascending.

Abdominal Binders.—These binders are made of unbleached muslin and are in three sizes. The largest size is fifty inches in length and sixteen inches in width. The medium size is forty inches in length and thirteen inches in width. The smallest size is thirty-six inches in length and twelve inches in width.

The bandage is made by taking a piece of unbleached muslin of the length required and folding it lengthwise, it is then stitched across the ends and side.

The roller is placed beneath the hips, while the patient is lying down, [illegible] falling over the table. The required amount of gauze and [illegible] e abdomen. The bandage is then brought around [illegible] t of the ilia so that its lower border is

just above the major trochanters. It is crossed in front very snu
secured with safety pins. From the crests of the ilia to the upper
of the bandages, it is pinned loosely. Each side, from the crest of
to the top of the bandage, is then gored, and as much of the slack pı
as is possible and secured by safety pins. This causes the bandag
evenly and snugly throughout its course and prevents it getting
place. In order to insure its being held down firmly, two straps are
in front, near the center line, and carried between the thighs to tl
where they are secured by pins. In females an additional pad of g
pinned over the front and carried down over the perineum (Fig. 59

Fig. [illegible] Spica bandage of the right groin with pelvic turns.

Spica Bandage of the Right Groin Ascending.—Roller t
one-half inches in width and seven yards in length. The initial ex
of the bandage is placed just below the anterior superior spine of th
The roller is then carried downwards and inwards some four or six
where it is made to completely encircle the thigh from before bac
and from within outwards. The bandage is then carried across th
of the thigh and made to cross the first bandage near the center. It
carried diagonally across the lower part of the abdomen, ascending
crest of the ilium, thence across the back and just below the

superior spine and brought down again across the front of the thigh. This completes the first turn. These turns are continued, each one overlapping two-thirds of the preceding, until the region is covered, when the bandage is secured with a pin (Fig. 60).

SPICA BANDAGE OF THE RIGHT GROIN WITH PELVIC TURNS—ASCENDING.—Roller two and one-half inches in width and nine to ten yards in length. The bandage is fixed by placing the initial extremity just below and posterior to the anterior superior spine of the ilium. The roller is then carried twice about the body to fix the bandage. As the roller comes about the right side the second time it is carried down across the front and around the right thigh, then across the front of the lower abdomen to above the crest of the ilium, and then across the back and a circular turn made about

Fig. 62.—Spica bandage of the right groin, descending.

the body. The next turn goes across the groin and about the thigh. The turns over the groin and thigh should cross each other in the center line. The turns about the body and thigh alternate, and each one should cover in two-thirds of the preceding. Those upon the thigh are ascending, while those upon the abdomen are descending. This bandage is secure, will not slip and is especially serviceable to hold dressings in position about the groin and for the covering of hernial wounds (Fig. 61).

SPICA BANDAGE OF THE RIGHT GROIN—DESCENDING.—Roller two and one-half inches in width and seven yards in length. The initial extremity of the roller is placed just above the right anterior superior spine of the ilium. The roller is then carried down over Poupart's ligament and around the thigh and brought back so that it covers the first turn above Poupart's

ligament. It is then carried diagonally across the pelvis and below the superior spine of the ilium of the left side and diagonally across the back to the right side, where it is made to cover in two-thirds of the preceding turn. These turns are continued from above downwards until the groin is covered. The bandage is secured with a pin. This bandage is used for the purpose of holding dressings to the groin (Fig. 62).

Spica Bandage of the Buttocks—Ascending.—Roller two and one-half inches in width and seven yards in length. The bandage is secured by two turns about the thigh just below the gluteal fold. It is then carried obliquely upwards across the buttock and beneath the crest of the

Fig. 63.—Spica bandage of the buttocks—ascending.

opposite ilium. It is then brought obliquely downwards across the abdomen and thigh and made to encircle the thigh. It is then carried upwards to the crest of the ilium. These turns are continued until the entire buttocks is covered. Each turn covers in two-thirds of the preceding. The bandage is completed by carrying it twice around the body. This bandage is employed to hold dressings in place on the buttocks and upper portion of the thigh (Fig. 63).

Perineal, Scrotal and Abdominal Bandages.—Two rollers two and one-half inches in width and seven yards in length. The scrotum is lifted up and supported by several layers of gauze. Gauze is also placed over the inguinal regions and above the pubis. A piece of absorbent cotton an inch

in thickness, six inches in width, and one foot long is placed beneath the scrotum and over the perineum, while the body and end of the strip falls over the right inguinal region and lower abdomen. Another similar strip is placed beneath the scrotum and along the left inguinal region, and a smaller strip is secured over the lower abdomen and upon the pubis. The initial extremity of the bandage is placed over the epigastrium and the bandage secured by carrying the roller twice around the body. The roller is then carried over the left hip, around the thigh and across the perineum from left to right, holding the scrotum well up against the pubis. It is then carried along the right inguinal region to a point above the crest of the ilium, and then a circular turn made about the body. As it comes back over the abdomen from left to right the roller is carried over the right hip and around the right thigh and across the perineum from right to left, up

Fig. 64.—Perineal, scrotal and abdominal bandage.

the left inguinal region and circularly around the body; when coming back over the abdomen from right to left, the bandage is conducted over the left hip again, around the left thigh and across the perineum from left to right, then carried up the right groin to the crest of the ilium, when it is conducted around the body. These turns are continued until the perineal, scrotal, and abdominal regions are entirely covered in.

The turns should be put on snugly, while the patient's knees are slightly flexed. Each turn of the bandage should overlap two-thirds of the preceding one. Those upon the abdomen run from above downwards, while those over the perineum are from behind forwards. The bandage is secured by placing several pins in the perineal region and over the groins and abdomen, where [illegible] s cross

This bandage is very serviceable for the purpose of giving support and holding dressings in place after hernial and scrotal operations. It also makes an excellent scrotal suspensory (Fig. 64).

Suspensory Bandage for Scrotum—Roller two and one-half inches in width and nine yards in length. The bandage is fixed by carrying it twice around the pelvis from right to left. It is then carried over the outside of, and around, the left thigh and across the perineum from left to right, and up the right inguinal region, when it is carried circularly around the body, coming back over the abdomen from left to right. It is carried over the right hip and around the right thigh, across the perineum from right to left, and up the left groin and then circularly around the body. It is then passed down the right groin and beneath the scrotum, and up the left groin and circularly around the body, and again down the right groin

Fig. 65.—Suspensory bandage of scrotum.

and under the scrotum and in a circular manner around the body. These turns are continued until the scrotum is well supported and entirely covered in. Several pins are then placed in the perineum to unite the different layers of bandage and prevent those which are suspensory to the scrotum from slipping upward. This bandage is very serviceable after operations upon the scrotum (Fig. 65).

Figure-of-Eight Bandage of the Knee.—Roller two and one-half inches in width and five yards in length. The bandage is fixed by carrying it twice about the lower third of the thigh. It is then carried across the popliteal space to the upper third of the leg where a circular turn is made. It is then brought backwards across the popliteal space and a turn made about the thigh. These circular turns are continued, each one covering two-thirds of the preceding, until the knee-joint is reached. One or two

circular turns are then made about the knee and the bandage secured witl a pin (Fig. 66).

The figure-of-eight bandage may also be applied to the knee by makin the primary turns directly around the joint and over the patella and thei continuing the bandage by figure-of-eight turns above and below the knee Those above ascending, while those below descend (Fig. 67).

SPICA BANDAGE OF THE FOOT WITH SPIRAL-REVERSED BANDAGE OI THE LEG.—Roller two and one-half inches in width and five yards ir length. The initial extremity of the bandage is placed over the externa malleolus and the roller carried obliquely across the instep to the metatarso

Fig. 66.—Figure-of-eight bandage of the knee.

phalangeal joints, when it is carried twice about the foot. The bandage is then continued up the foot by making spiral, or spiral-reversed, turns When nearing the tarsus it is carried along the internal border of the foot around the heel, along the external border, across the instep and aroun the sole. Figure-of-eight turns are continued until the heel is covered in The bandage is then made to pass around the leg in spiral-reversed turns each turn covering in two-thirds of the preceding (Fig. 68).

BANDAGE OF THE FOOT NOT COVERING THE HEEL WITH SPICA BAND- [illegible] LEG.—Roller two and one-half inches in width and seven yards in length. The initial extremity of the bandage is placed over the external malleolus, and the roller carried across the instep to the metatarso-phalan-

Fig. 67.—Figure of [illegible]

[illegible] the foot with [illegible]

[illegible] turns are [illegible] up
[illegible]. Two figure [illegible] ole
[illegible] bandage [illegible] by
[illegible] Fig. 60).

Fig. 69.—Bandage of the foot not covering the heel, with spica bandage of leg.

Spiral-Reversed Bandage of the Lower Extremities.—Two rollers two and one-half inches in width and seven yards in length. The initial extremity of the bandage is placed over the external malleolus, and the

Fig. 70.—Spiral reversed bandage of the lower extremity.

Fig. 71.—Spica or figure-of-eight bandage for the lower extremity.

roller carried across the instep to the metatarso-phalangeal joints and secured by two circular turns about the foot. The bandage is then carried

up the foot by spiral, or spiral-reversed, turns until the ankle is reached, when two figure-of-eight turns are made about the ankle and foot. It is then continued up the leg by making spiral, or spiral-reversed, turns until the upper portion of the calf is reached, when circular turns are made with figure-of-eight turns about the knee. The bandage is then continued up the thigh by spiral-reversed turns until the groin is reached when two figure-of-eight turns are made about the pelvis and thigh and the bandage secured with a pin (Fig. 70).

SPICA OR FIGURE-OF-EIGHT BANDAGE FOR THE LOWER EXTREMITY.—Two rollers, one two and one-half inches in width, seven yards in length, the other three inches in width and seven yards in length.

The initial extremity of the first bandage is placed over the external malleolus and the roller carried obliquely across the instep to the metatarso-phalangeal joints, where two circular turns are made about the foot. The bandage is then carried up the foot by spiral or spiral-reversed turns until the instep is reached, where two figure-of-eight turns are made about the ankle and instep. The bandage is then continued up the leg and thigh by spica, figure-of-eight, ascending and descending turns until the groin is reached, when two figure-of-eight turns are made about the pelvis and thigh, and the bandage fixed with a pin. This and the spiral reversed bandage are used after fractures and wounds of the lower extremity to hold splints and dressings in position (Fig. 71).

RECURRENT BANDAGE OF THE STUMP.—Roller two and one-half inches in width and six yards in length. Place the initial extremity of the bandage six inches above the end of the stump and carry the roller over the stump and up the opposite side to a point corresponding to the initial extremity of the bandage. Recurrent turns are then made forwards and backwards, each turn covering two-thirds of the preceding until the entire stump is covered in. Then two or three circular turns are made around the stump for the purpose of securing the recurrent turns and for the purpose of fixation. The roller is then carried down to the end of the stump and it is covered in by spiral-reversed turns. The bandage may then be carried up the limb by spiral-reversed turns for a suitable distance. The extremity of the bandage is then secured with a pin. In amputations through the calf of the leg, or forearm, the bandage should be carried above the knee or elbow respectively and then fixed by circular turns. In amputations through the thigh or arm, the roller should be carried about the pelvis or chest, otherwise the bandage with the dressings are liable to slip off the stump (Fig. 11[illegible]).

GAUZE OR MUSLIN BANDAGES FOR THE HEAD, NECK, AND CHEST.—Following severe operations about the neck, as in the removal of tubercular glands or the thyroid gland, it is necessary in order to secure the dressings in position, to protect the area from exposure to the air and to immobilize the parts, to enclose the head, neck, and upper portion of the chest in a proper bandage. This may be accomplished by carrying the roller several times about the neck and then over the head, both perpendicularly and circularly, and again around the neck. The roller is then carried around the chest by making circular and figure-of-eight turns. The bandage is then carried around [illegible] head and back to the chest, until the parts are well pro-

tected and immobilized. This is not only a very comfortable bandage, but one which gives excellent support and protection to the parts (Fig. 72).

PLASTER OF PARIS BANDAGES.—These bandages are made of gauze or cross barred crinoline, by spreading upon their surfaces or rubbing into their meshes, a suitable amount of plaster of Paris. The plaster of Paris should be such as is used by dental surgeons. It must be fresh or not have been exposed to the air. These bandages may be purchased in the market or prepared by the surgeon or his assistants. An ordinary kitchen table is very suitable on which to roll them. One end of the bandage is laid on

[illegible] chest.

the table, while the [illegible] the floor. The plaster is then [illegible] or a sifter is used for this purpose [illegible] while the plaster is being applied [illegible] they should be wrapped in paper [illegible]

In applying [illegible] commences should first be protected [illegible] with a bleached muslin [illegible] a dish of cold water of sufficient [illegible] bubbles cease to

rise the bandage is ready for use. It is then taken out of the dish gently squeezed to rid it of its surplus of water and applied to the limb by simply unrolling it. The surface of the bandage which contains the plaster of Paris should always be uppermost. It should not be reversed, but when applied to a part which increases rapidly in size, the lower edge is folded back upon itself. By this means the bandage can be applied smoothly while the plaster is always upon the outer surface. While carrying the roller about the limb the plaster should be rubbed well into the previous turns so as to form a firm and solid cast. By this means a large amount of strength is secured from the least amount of material. The thickness of the cast will depend upon the amount of resistance to be met. For immobilizing the ankle a single roller, two and one-half inches in width and five yards in length, will be sufficient. For immobilizing the knee of an adult at least three such rolls are required. The leg, thigh, and pelvis will require from six to ten rolls. Weak points in a cast may be rëinforced by rubbing moist plaster into the part. An area which has considerable strain put upon it, as the knee or hip, may be strengthened by inserting in the cast pieces of shingle or thin strips of board. Rapid "setting" of the plaster may be facilitated by adding a little common salt to the water in which the bandages are immersed.

CHAPTER II.

DETAILS BEFORE AND AFTER OPERATION.

THE OPERATING ROOM.

The operating room in hospitals is usually situated on the top floor. It should be large, well ventilated, with high ceilings, and preferably have a north exposure and be provided with a skylight. The floors and the walls to the height of four or five feet should be tiled. The ceiling and the remainder of the walls may be painted. All of the operating furniture should be porcelain, enamel, metal or glass. Sterilizing, etherizing, bath, and dressing rooms should join the operating room.

CARE OF THE OPERATING ROOM.

The walls of the operating room should be washed at least once in two weeks with soap and water. The operating table is washed with soap and water, and has the pads changed, after every operation. The soiled sponges and towels are brushed up from the floor, which is then mopped.

After every series of operations and after every pus case the entire furniture and floors should be gone over with soap and water, and then with a solution of bichloride of mercury, 1 to 1,000. The windows are usually kept closed, barring the ventilators which are covered with non-absorbent cotton filters. The temperature should be from 75° to 80° F.

Once a month, and also following all severe septic cases, the operating room should be disinfected with formalin.

All basins, pitchers and bowls are scrubbed with soap and water and rinsed with bichloride of mercury, 1 to 1,000. After septic cases they should be boiled.

PREPARATION OF INSTRUMENTS.

These are usually kept in glass and metal cases. Edged instruments are sterilized by boiling for from two to five minutes in a 1 per cent. solution of carbonate of soda. Other instruments are boiled for from five to ten minutes. The sterilizer should be covered and there should be sufficient soda solution in the sterilizer to completely immerse the instruments. The instruments are sterilized just before being used and on removal from the sterilizer they are either kept in trays containing sterilized water, or are placed upon a table covered with sterilized towels. After use the instruments should be washed in cold water to remove blood stains, and then sterilized in the soda solution for ten minutes. They are then dried, thoroughly polished and replaced in the case.

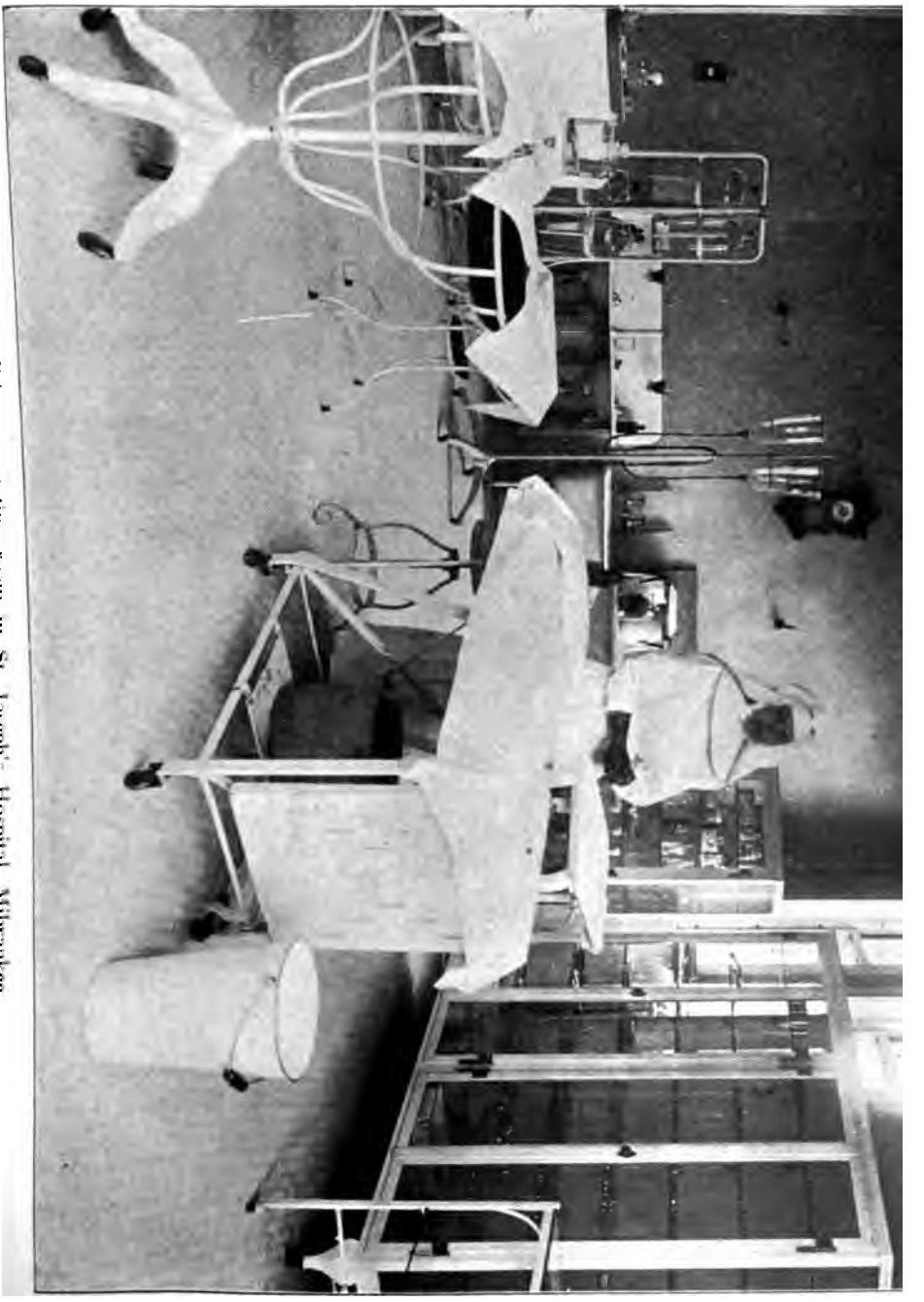


Fig. 73.—Private operating room in St. Joseph's Hospital, Milwaukee.

Brushes are sterilized by boiling for twenty minutes in a ten per cent. solution of bichromate of potash. They are kept in glass-covered jars containing the same solution, to which is added bichloride of mercury, 1 to 1,000.

Rubber gloves are enclosed in a towel or piece of gauze and sterilized by boiling for five minutes in a saline solution.

Towels, gowns, sheets and blankets are done up in proper packages and placed in the sterilizer for one-half hour shortly before being used. All water used in the operating room should be filtered and then sterilized, and all solutions are to be carefully labeled.

PREPARATION OF SOLUTIONS.

Normal salt solution is made by adding one drachm of sterile salt to a pint of sterilized water.

Bichloride of mercury solution is made by using a seven and one-half grain tablet to one pint of water, which makes a 1 to 1,000 solution.

Two and a half drachms of carbonate of soda to a quart of water make a one per cent. solution for sterilizing instruments.

Six ounces of boric acid to a gallon of water makes a saturated solution. The crystals should be added while the water is hot.

Two and a half drachms of carbolic acid in a quart of water makes a one per cent. solution.

PREPARATION OF SPONGES.

These are made of four sizes.

1. Stick sponges. A piece of gauze eight inches square is taken and three inches of each corner, folded inwards towards the center. Then the

Fig. 74.—Preparation of the stick sponge.

ends and sides are folded to the center. The folded piece of gauze is then laid flat upon the forefinger and thumb of the left hand, when the center of the piece is pressed downwards between the thumb and finger by the forefinger of the right hand (Fig. 74). The gauze is now held tightly by the thumb and forefinger of the left hand, while the tip is given two turns by the fingers of the right hand. This makes a very convenient sponge to be used with the fingers or forceps, when the bleeding is not severe (Fig. 75).

2. Larger sponges are prepared for superficial work when the hemorrhage is profuse by having a piece of sterilized gauze at hand which has been folded lengthwise four times and rolled like a large bandage. From this pieces are cut four to eight inches long to meet the requirements of the case.

Fig. 75.—Preparation of the stick sponge.

3. Laparotomy sponges. These are made by taking a piece of gauze a yard wide and fifteen inches long and folding it lengthwise three times. The ends are then hemmed and the sides stitched, and a piece of white tape ten inches long sewed to one corner.

4. Sponges for packing off the field of operation. These are made from pieces of gauze twelve inches wide and three-quarters of a yard long and folding them lengthwise three times. The ends are turned in and hemmed and the sides stitched. Each set of sponges is done up in a separate package and sterilized on three successive days, the first day for one hour and the two succeeding days for one-half an hour. The packages are not opened until the patient is anesthetized and the sponges required.

PREPARATION OF SILK AND SILKWORM GUT.

These articles are enclosed in gauze and sterilized with the sponges du ing three successive days. After sterilization the silk is kept in absolu alcohol and in glass-covered jars. The silkworm gut is kept in a ten pe cent. solution of carbolic acid and in glass-covered jars.

PREPARATION OF AN OPERATING ROOM IN A PRIVATE HOUSE.

In a well regulated and modern hospital the surgeon has only to thin of his personal preparation and the preparation of his assistants. But a some operations, not from choice but from necessity, have to be done i private houses, it is well to consider the preparation of the room in whic the operation is to be performed.

A room of good size should be selected and one having an excellen amount of light. If possible on the day preceding the operation, all hang ings and superfluous furniture should be removed. That portion of th room in which the operating table is to stand should be free from carpet o rugs. The walls and floor are then thoroughly swept, the room well aired after which it is closed for two or three hours to allow the dust to settle.

The walls, woodwork and floor are then thoroughly gone over with a cloth wrung out of a solution of bichloride of mercury or carbolic acid. Th room may then be closed for the night.

On the morning of the operation any places especially exposed are agai wiped off with a damp cloth. Any remaining pieces of furniture, as wel as the walls adjacent to, and the ceiling over, the operating table may b covered with sterilized sheets.

A clean, narrow table is provided for the operation and covered wit a folded blanket. Over this is placed a piece of rubber sheeting and then a sterilized sheet. Two small accessory tables are provided covered wit sterilized towels. These are for the basins, dressings, instruments and ligatures. Plenty of sterilized water, both hot and cold, should be at hand in covered aseptic pitchers or pails. The paraphernalia will also include from four to six new tin or granite basins which have been rendered aseptic by scouring, scrubbing and boiling, and placed bottom up on one of the small tables, until wanted. These arrangements are completed as the patient is being anesthetized. Ordinarily the preparation of the room and its belongings will be in the hands of a trained and skilled nurse, who will need few if any instructions from the surgeon.

PREPARATION OF THE PATIENT.

The patient should enter the hospital the day previous to the operation, and be given a warm bath, during which the entire body is vigorously scrubbed with soap suds and water and a soft brush. Particular attention should be given to the hands and feet, axilla, genitals and anal region. The nails should be cut short and the subungual places well scrubbed. A specimen of fresh urine is now secured and set aside for examination. The patient is then put to bed in clean clothes, and a brisk cathartic administered. Some preparation of salts is usually to be preferred. In the evening an enema of soap suds and water is administered and this should be r

on the morning of the operation. After the patient is put to bed the part to be operated on is shaved, if hairy, thoroughly scrubbed with soap and water, wiped dry with a sterile towel and then washed with a sixty per cent. solution of alcohol, and then with a solution of a bichloride, 1 to 2,000. A wet compress of bichloride of mercury is then applied to the part, this is covered with a dry dressing and held in place by a bandage.

The food during the twenty-four hours preceding the operation should be simple and easily digested.

In the writer's clinic where the hours are from nine to eleven A. M., the patient receives no food on the morning of the operation unless very weak, in which case a cup of hot broth is given early in the morning. At the time of the operation there should be no undigested food, and as little material as possible, in the gastro-intestinal canal. Unquestionably much of the nausea, vomiting, restlessness, general discomfort and fever arising after operations, comes from an imperfect cleansing of the alimentary canal. The loss of strength and lowered vitality succeeding an operation, the disturbance or arrest of function, the necessary inactivity of the bowels, favor putrefactive processes in any organic undigested material which may be present in the alimentary canal at the time of operation. During the occurrence of these processes, ptomaines are formed in great quantities and, being absorbed, cause nausea, vomiting, restlessness, fever and it may be severe delirium.

An examination of the blood should be made in all cases of marked anemia and of chronic infection. If the hemoglobin is below fifty per cent. it should be increased, if possible, before operation. The heart and lungs should be examined by the house surgeon and the anesthetist.

If the examination of the urine shows a marked pathological condition of the kidneys or bladder, this should be corrected if possible before operation.

Before the patient goes to the anesthetizing room he should be given, if an adult, one-thirtieth of a grain of strychnine and one-eighth or one-quarter of a grain of morphine, hypodermically.

Before the patient is fully anesthetized he is brought to the operating room, the temporary dressing removed, and the part to be operated upon rescrubbed with soap and water, and then wiped dry with a sterile towel and washed with alcohol and a bichloride solution.

PREPARATION OF THE OPERATOR AND HIS ASSISTANTS.

There is no doubt but that the surgeon or his assistants frequently infect the wounds they make. At times this may be accidental or perhaps unavoidable. With surgeons who do not operate very much it often occurs from carelessness, indifference, or perhaps from a failure to correctly grasp the requirements of aseptic work. It is too often thought that a mere scrubbing of the hands and a brushing of the nails is all that is necessary in order to secure asepsis. How often is the occasional operator or assistant, after preparing his hands, seen to touch, unconsciously, articles of furniture or [illegible] his clothing or person which have in no way been sterilized! [illegible] order to obtain the best possible results must not only be [illegible] but he must also maintain a reasonable aseptic condi-

Fig. 77.—Operating room nurse in proper dress.

[illegible] good bodily cleanliness. There is no doubt [illegible] some surgeons to do aseptic work and to [illegible] without disturbance than it is for others, and

one may infer that while great attention has been paid to the preparation of the hands but little or none has been devoted to the cleanliness of the body, the condition of the clothing or the state of the health. It is unwise to divorce these conditions from that of the hands. The morning bath and the frequent change of underwear will not only assist in maintaining vigor and preserving health, but will also very materially aid in keeping the surgeon in a comparatively aseptic condition (Fig. 76).

Before entering the operating room the street shoes and outer clothing should be put off and in their place duck pants, a long white gown with short sleeves, and white canvas shoes with thick rubber soles put on. This attire not only adds to the ease and comfort of the surgeon, but also assists greatly in maintaining him and the operating room in an aseptic condition. Pantaloons and shoes worn day after day in an operating room, where they are splattered, splashed and perhaps soaked with blood, or pus, are not in a condition helpful to asepsis, and if for no other reason than ordinary cleanliness, decency and precept, should be changed before entering the operating room, for materials more nearly aseptic in character (Fig. 77).

PREPARATION OF THE HANDS.

In all the antiseptic technic pertaining to modern surgery, the preparation of the hands is the most difficult if not the most important. While perfect asepsis is unquestionably an unknown quantity and not essential to success, a reasonable approximation to asepsis is necessary in order to prevent infection of the wound. A smooth skin surface is easily rendered aseptic, while the hands, with their numerous irregularities, clefts, grooves and areas beneath the nails, present a problem for asepsis most complex. The hands, even of persons not engaged in the practise of medicine, are not only always exposed to infection, but also constantly contaminated, while the surgeon's hands in his operative work in pyogenic cases and in the treatment of septic wounds, are occasionally simply steeped in the most virulent infectious material. It is scarcely necessary to state that the surgeon who contaminates his hands the least in septic operations and in the dressing of septic wounds will have the least difficulty in rendering them aseptic.

METHODS OF HAND STERILIZATION.

The fact of there being so many methods is very good proof that none is quite satisfactory. Still the results of any method will depend very much upon the manner and thoroughness of its application. That there is a great difference in the application of aseptic and antiseptic principles by different operators, even when endeavoring to follow the same technic, is made apparent by a visit to different clinics. In one the work being systematized and done with thoroughness, precision and order, is followed by the best results, while in another there is carelessness in preparation with confusion and disorder, and as the result many breaks occur in the aseptic chain. Not all of failure therefore can be charged to the method of sterilization, but very much must be placed to the manner of its application. The method of Furbringer, more or less modified, is in favor with many surgeons.

As applied in St. Joseph's hospital it is as follows: The hands and forearms are first thoroughly scrubbed with a sterilized brush and liquid soap,

Fig. 76.—Operator's assistant in proper dress.

tion of his hands and a state c
that it is much more difficult
attain primary wound healing

geon's dress as described, is aseptic, light, cool, comfortable and a thing of pleasure and security in which to work (Fig. 76).

CARE OF PATIENT FOLLOWING OPERATION.

A successful result often depends as much on the after treatment as it does upon the operation itself. The patient should be placed in a warm bed and carefully watched by a competent nurse until fully conscious. If the patient is in shock, or has suffered much from loss of blood, the head should be lowered and the foot of the bed elevated. At the same time he should be surrounded with hot water bags or bottles. For shock, pain and undue restlessness, sufficient morphine should be given to relieve the pain and quiet the patient. Strychnine is given in full doses, with caffein, to support the heart, and if the latter's action is rapid, 1-50 or 1-25 of a grain of digitalin may be administered hypodermically every two or three hours. In practically all cases where the patient is weak, has suffered the loss of considerable blood, or has passed through an abdominal operation, it is of the greatest advantage to inject into the rectum a pint of warm coffee and milk. The latter should be peptonized. These injections may be repeated every two or three hours and continued for two or three days, or a pint of warm normal salt solution may be used.

The position of the patient following the operation will depend upon the condition found and the character of the operation performed. In operations for septic peritonitis the patient is usually placed in a sitting posture, while in operations for empyema, and in some abdominal operations, he is often placed on his side.

ANESTHETIC VOMITING.

If the patient is free from naso-pharyngeal catarrh, and the stomach is empty before the administration of the anesthetic, vomiting is usually not severe or prolonged. Vomiting is usually most severe following abdominal work. In some neurotic patients and in those with a susceptible stomach, vomiting may be difficult to control. Excessive vomiting greatly exhausts the patient, is liable to weaken the suture line in abdominal cases and may lead to aspiration-pneumonia. During recovery from anesthesia, and especially during vomiting, the patient's head should be turned to the side to favor the flow of the secretions and material ejected from one angle of the mouth. Vomiting may often be prevented or arrested by placing the patient in a half sitting posture. In some cases vomiting may be controlled by a hypodermic injection of one-eighth of a grain of morphine, by applying a mustard paste over the epigastrium, by giving small quantities of champagne by the mouth, or by placing dry upon the tongue a powder composed of one grain of bismuth, one grain of oxalate of cerium and a twelfth of a grain of cocaine. As a rule, however, if the vomiting is continued it is desirable to avoid all fluid and medicine by the mouth. If the stomach is quiescent a teaspoonful of warm water may be given at frequent intervals during the first day following the operation. During the second day the hot water is continued and warm tea or a little hot milk added. During the fore part of the third day two or three grains of calomel may be given in divided doses, followed by several ounce doses of citrate of magnesia. The magnesia, if

necessary, is followed by a soap suds and water enema. After the bowels have acted thoroughly the patient under ordinary conditions may be put upon a light liquid diet. After the third day the bowels should be moved daily.

GENERAL APPEARANCE OF THE PATIENT.

The experienced surgeon can tell almost at a glance the condition of his patient by the facial expression. Patients who are doing well have a happy, contented, satisfied expression of countenance. In cases where there has been hemorrhage the face is blanched, lips colorless, nostrils distended, pupils dilated, respiration rapid, patient restless and the skin often covered with a profuse, cold perspiration. In peritonitis the features are pinched, eyes sunken, face anxious, patient depressed, and vomiting frequent. In pneumonia the face is anxious, often dusky in color, respiration short, frequent and labored.

CONTROL OF PAIN.

Ordinarily one-eighth to one-quarter of a grain of morphine may be given hypodermically during the first night, for the purpose of controlling pain and inducing sleep. During the second and third days, codein in one-quarter grain doses may be substituted. It should be a cardinal rule following operations to give as little opiate as possible, as it disturbs the gastro-intestinal canal, lessens the appetite and interferes with the secretions and excretions. Following the first three days some one of the hypnotics may be given at bed-time, if necessary, for the purpose of inducing sleep.

THIRST.

As already stated practically every patient, following a laparotomy or other severe operation, and especially every weak patient, should receive upon being put to bed a rectal enema of one pint of milk and coffee at a temperature of 100° to 105° F. The enema should be repeated at intervals of four hours until the patient can take sufficient food by the mouth to sustain his strength. Instead of coffee, normal salt solution may be added to the milk; or broths may be substituted, or the saline solution may be given alone. Rectal enemata not only allay thirst by suplying fluid to the system, but support the patient and re-establish the secretions and excretions. In addition to the rectal enemata, the patient is given small quantities of warm water by the mouth.

GENERAL CARE OF THE PATIENT.

Immediately following operation the patient must be protected from cold. This is especially true of the head and chest. Pneumonia is not infrequent following severe operations, especially laparotomies. This at times is due to the aspiration of materials vomited into the bronchi, but it probably more often has its inception in the severe chilling of a body whose vitality and powers of resistance are already greatly lowered in consequence of the operation and anesthetic.

THE URINE.

The urine should be carefully watched and the amount passed each day recorded. A chemical and microscopical examination of the urine should be made following the operation and before the patient leaves the hospital.

TEMPERATURE AND PULSE.

In severe cases the temperature and pulse are to be taken every hour. In ordinary cases they are taken every four hours for three days, and then night and morning.

In consequence of shock, or a condition of lowered vitality, the temperature may be subnormal following the operation, and subsequently during the morning hours. If the patient is conscious and perfectly rational the temperature may be taken by the mouth, otherwise it should be taken per rectum.

As a rule following all severe operations, even in perfectly aseptic cases, the temperature rises one, two, or even three degrees F. This rise may be maintained with some variations for two or three days. The patient, however, feels and looks well. A temperature which persists for more than two or three days is usually indicative of wound infection, or of some pathological process going on in the body.

Following some operations, or as the result of loss of blood, marked weakness or great nervousness, and in susceptible persons the pulse may reach 120 to 140 beats per minute. This need, however, ordinarily cause no alarm, as with rest or under the influence of strychnine digitalin and caffein, and unless there is some severe pathological process going on, it soon returns to the normal, or to near normal rate. Not only the rapidity of the pulse, but its quality is to be noted, and in connection with the temperature the number of respirations should be counted and recorded.

Daily sponge baths, followed by alcohol rubs, are refreshing and of the greatest benefit to the patient.

The tongue and teeth should be kept clean, the hair carefully brushed and the fingernails cared for.

Fresh air and sunlight, harbingers of good cheer and the return of health, should be freely admitted to the room. Very few if any visitors are permissible during the first three days following severe operations.

The general surroundings should be pleasant and the patient cheered, encouraged and made hopeful.

CHAPTER III.

SURGICAL ANESTHESIA

By anæsthesia [illegible] insensibility to pain. An anæsthetic is an agent [illegible] condition. Anæsthetics are [illegible] The general anæsthetic is one which [illegible] the entire body with loss of consciousness. [illegible] insensibility over the region [illegible] anæsthesia is a condition in which a [illegible] insensible by local injections. As a result [illegible] which these nerves supply is rendered anæsthetic.

General anæsthesia [illegible] the inhalation of nitrous oxide gas [illegible]

Local anæsthesia [illegible] the application of cold in the form [illegible] one or two minutes; by a [illegible]

General anæsthesia [illegible] the purpose of producing unconsciousness [illegible] surgical operations [illegible] produce muscular [illegible] and physical examinations; [illegible] the passage of gall stones [illegible] anæsthesia is contra-indicated in cases of [illegible] diseases [illegible] diseases of the lungs [illegible] surgical practice it should be [illegible] the heart and test the [illegible] should be empty, [illegible] from the mouth.

NITROUS OXID GAS

This agent [illegible] arresting oxygenation of the blood [illegible] oxid gas is contra-indi- [illegible] and in obstructed [illegible] gas [illegible] produces uncon- [illegible] three deep inhalations [illegible] a slight tremor, the [illegible] stertorous, and the face [illegible] anæsthesia with insensibility. [illegible] the anæsthetic is [illegible] regains consciousness with- [illegible] oxid gas is suitable [illegible] danger, the quickness

of its action, and the absence of subsequent disagreeable sympt
is also frequently used to produce anæsthesia preliminary to the
tration of ether. Nitrous oxid gas when mixed with oxygen may
for longer periods without producing such marked symptoms of a
The mixture is given by a special apparatus by which the amount of
can be increased or diminished. Cyanosis, stertor and muscular

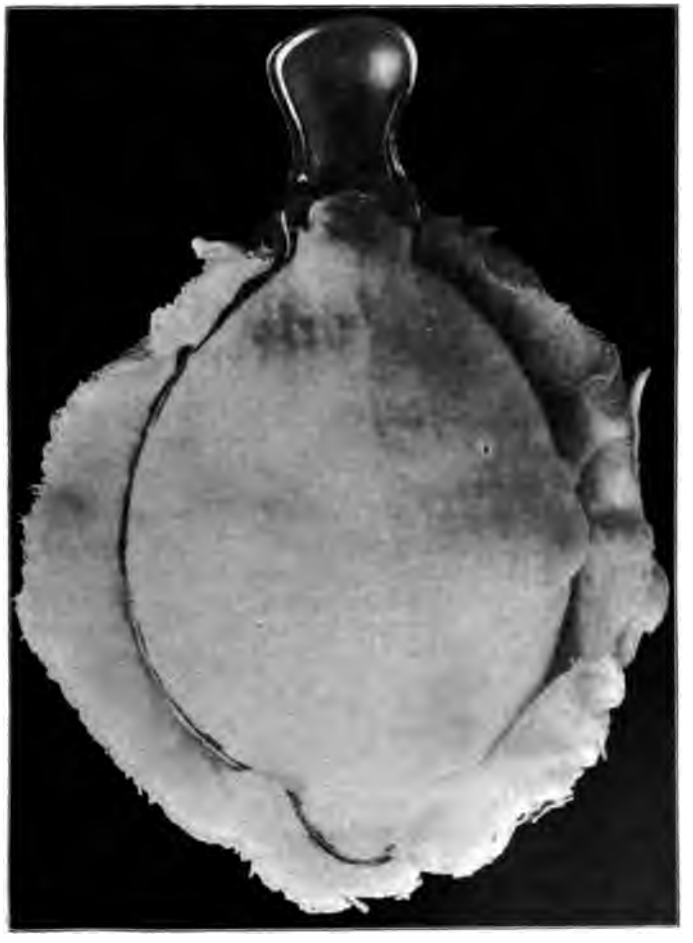


Fig. 78.—Outside of an Esmarch inhaler.

ings call for an increase of the oxygen, while indications of returni
sciousness call for its diminution. The apparatus for the administr
nitrous oxid gas consists of a metal cylinder in which the gas i
under high pressure, a rubber bag connected by a flexible tube
cylinder and with the hollow spherical face mask, provided with
to allow the escape of expired air.

ETHER.

Ether is the safest of the general anæsthetics except nitrous oxid ga In its administration, according to Hare, the parts affected are, first, th brain, then the sensory tracts of the spinal cord, then the motor tracts, th sensory side of the medulla, and following this the motor side followed b death if too much ether is given.

Before administering ether the nose, lips and bordering parts of th cheeks and chin should be smeared with vaseline, in order to counterac the irritating effect of this substance upon the skin.

The vapor is preferably given on an ordinary Esmarch inhale (Fig 78) should be administered very gradually at first, so as no to alarm the patient. Small and frequently interrupted streams of ether ar allowed to fall upon different points of the inhaler. With the inhalation of ether there is at first a sensation of giddiness with slight intoxication and often a sense of constriction about the larynx with a free secretion of mucus from the fauces. If the vapor is given too freely a sensation of choking is experienced. With the continuance of the ether the face becomes flushed, the pupils dilated the [illegible] and the respiration is increased in frequency. Very often patients [illegible] belong to the laboring class or who have a low state of mental [illegible] as well as alcoholics become during this stage greatly excited and frequently struggle severely with their attendants or they may [illegible] become [illegible] the speech usually being incoherent. There may be slight muscular spasms [illegible] the continuation of the anæsthetic the respirations become [illegible] and fuller the muscles relax the conjunctival reflex is [illegible] the [illegible] are normally contracted and the patient seems to be [illegible] This is the state of unconsciousness [illegible] sufficient ether should be given to [illegible] The best [illegible] is the conjunctival reflex [illegible] the stage of excitement [illegible] less rapidly until this stage is passed.

CHLOROFORM.

The effects [illegible] are much the same as those [illegible] the fauces and nose, less [illegible] The [illegible] The stage of excitement [illegible] closure of the [illegible] depressing effects of the [illegible] and demands prompt [illegible] Heart failure as shown [illegible] irregular [illegible] effect of the drug [illegible] warning [illegible]

[illegible] the drug [illegible] anæsthesia has been [illegible] respiration.

and the dilatation of the pupils are dangerous symptoms which re immediate attention and the withdrawal of the anæsthetic.

COMPLICATIONS ARISING DURING THE ADMINISTRATION OF GEN. ANESTHETICS.

Vomiting is frequent during and after anæsthesia; more frequent ether than chloroform. It may be due to the irritation of the anæs

Fig. 79.—Inside of an Esmarch [illegible]

upon the fauces; to an over-sensitive stomach; the toxic effect of the to nervousness, and frequently to the fact that the stomach is not emp

The treatment should be that of rest of the stomach, possibly application of a mustard paste over the epigastrium, or the administr

of teaspoonful doses of hot water. Sudden heart weakness and even death may suddenly follow anæsthesia. This may be due to an over-strain upon a chronically diseased heart, as during the stage of excitement while struggling with the attendant. It may also occur in consequence of having assumed the upright position. Patients with myocarditis should be carefully watched until full consciousness has occurred. Pulmonary irritation, bronchitis or pneumonia, are not infrequent, especially after the administration of ether. Ether pneumonia is especially frequent during the winter months and is probably the result of the irritation of the ether vapor, aided by the lowered vitality incident to the operation, and the effects of cold. Both ether and chloroform must be regarded as renal irritants. The appearance of albumen in the urine after operations is not infrequent, while anuria occasionally occurs, with fatal results. Chloroform or ether jaundice is of frequent occurrence. In a great many cases some two or three weeks after the operation patients become jaundiced, without any apparent cause. This in many cases is probably due to catarrh of the stomach, and probably in others to irritation of the biliary passages, incident to the toxic effects of the anæsthetic.

CHOICE OF AN ANESTHETIC.

For a short general anæsthesia nitrous oxid gas is to be preferred, as it is practically without risk, readily recovered from, and has no disagreeable after-effects. As between ether and chloroform, ether is the safer general anæsthetic. The report of the committee on anæsthetics of the British Medical Association in 1901 gave 18 deaths from chloroform in 13,393 cases, and no deaths from ether in 4,595 cases. Ether is to be preferred in healthy adults, in cases of myocarditis, and in shock. Chloroform is preferable in infancy and old age, in acute and chronic diseases of the lungs, arteries, and kidneys, and in operations upon the chest and air passages. Ethylbromid and ethylchlorid have been used to produce anæsthesia for short operations. Their advantages are that anæsthesia is quickly produced, readily recovered from, and without unpleasant effects.

LOCAL ANESTHESIA.

This was formerly obtained by freezing the part with ice, or a mixture of ice and salt. Ethylchlorid is now extensively used for the same purpose. This preparation is now to be had in glass tubes. These tubes have a screw or spring cap at one end, and by removing the cap or pressing upon the spring a fine stream of the fluid can be directed upon the part to be frozen. In from ten to thirty seconds the part turns white, the fluid congeals, and the surface of the skin is rendered anæsthetic. Ethylchlorid is very useful in office practice for the purpose of relieving the pain in many of the minor incisions.

COCAIN.

Weak solutions of cocain may be used with advantage for the purpose of infiltrating a certain area of the skin and subcutaneous tissue through which an incision is to be made.

SCHLEICH'S METHOD OF INFILTRATION ANESTHESIA.

This method has been extensively employed for the prevention of pain in minor and even in extensive surgical operations. Amputations, laparotomies, herniotomies, thyroidectomies, and the removal of tumors, have been done under infiltration anæsthesia. In these cases not only the skin, but the subcutaneous tissue and sensitive areas and sensitive nerves are infiltrated.

Schleich's formula No. 1 is as follows:

Cocain hydrochlorate,	.20
Morphine hydrobromate,	.025
Sodium chloride,	.20
Water to make,	100 parts

Sterilize and then add two drops of a five per cent. solution of carbolic acid.

There are two other solutions, either of which is preferable to the one given when large areas are to be infiltrated. One of these contains one-half the amount of cocain and the other one-twentieth.

In injecting an area through which an incision is to be made the needle is introduced down to the papillæ, and sufficient fluid expelled to render white and bloodless a small, circumscribed spot probably two-thirds the size of a ten-cent piece. The needle is then withdrawn and introduced at the border of this area, and another wheal produced. In this way a surface of one-fourth to one-eighth of an inch wide and as long as may be necessary can be made anæsthetic. If the incision is to include the deeper structures these can be injected by inserting the needle deeply into the tissues and then slowly injecting the fluid as the needle is withdrawn. The deeper parts and sensitive nerves can usually be infiltrated to advantage after the incision has been made through the skin.

A four per cent. solution of eucain applied locally to a mucous membrane will in four or five minutes produce complete insensibility. Upon the surface of the skin cocain has no effect. Occasionally following the use of strong solutions of cocain symptoms of intoxication occur, such as pallor, tremor, mild delirium, excessive perspiration, general weakness, and a rapid and feeble pulse. In very severe cases there is great prostration, syncope, and even death. The indications for treatment of cocain intoxication are to support the heart with strychnin and caffein, and promote elimination.

Eucain is a much safer local anæsthetic than cocain and may be used in a two to four per cent. solution, and has practically the same effects. Upon mucous membranes, such as the urethra and bladder, it should always be used in preference to cocain.

REGIONAL OR SPINAL ANESTHESIA.

Regional anæsthesia is obtained by injecting a nerve, either with or without exposure. Spinal anæsthesia was first suggested by Corning in and has been extensively resorted to for the prevention of pain in below the waist line.

TECHNIC.—A two per cent. solution of cocain is sterilized by placing a test tube containing the solution in boiling water for one minute. The patient is placed prone upon a table, and the lumbar region asepticized. A slender hypodermic needle three and one-half inches long is then introduced just to the outer side of the tip of the fourth lumbar spine and carried obliquely inwards and upwards between the laminæ of the fourth and fifth lumbar vertebræ until the subarachnoid space is reached. This is known by the appearance of a few drops of clear cerebro-spinal fluid at the end of the needle. A syringe containing the cocain solution is then screwed to the needle, and from eight to fifteen drops of the solution injected. The needle is then withdrawn and the wound closed with collodion. After a successful injection insensibility is usually complete through the pelvis and lower extremities. The upper limit of insensibility is usually situated somewhere between the umbilicus and pubis.

Spinal anæsthesia has frequently been followed by severe headache, vomiting and fever, and occasionally by temporary or complete paralysis. In a considerable number of cases death has occurred as the direct or indirect result of the injection. These deaths have been sufficiently frequent to establish the fact that spinal anæsthesia is more dangerous than general anæsthesia, and should only be recommended in cases in which general anæsthesia is contra-indicated.

CHAPTER IV.

SURGICAL BACTERIOLOGY.

Bacteria are microscopical unicellular plants, which vary much in size and shape. The cell substance is thought to be a vegetable protoplasm, and is either homogeneous or finely granular. The granules at times appear like particles of fat, starch, or sulphur. The cell protoplasm is surrounded by an envelope and at times a capsule, which, under intense staining, gives the appearance of a halo. Some bacteria are motile and are possessed of certain flagella or slender protoplasmic cilia (Fig. 80).

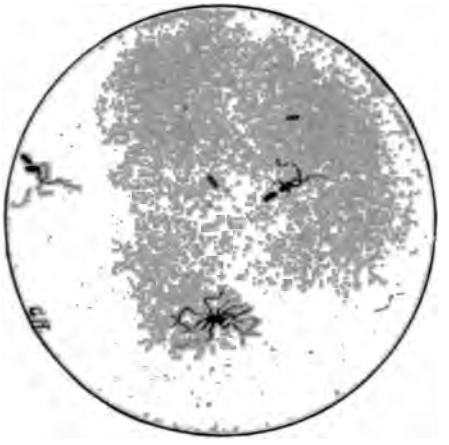


Fig. 80.—Bacteria with flagella. Bacillus Typhosus.

Bacteria have been classified into three families, according to their shape. These are the micrococcus, or globular; the bacillus, or rod-shaped; and the spirillum, or twisted form.

Bacteria multiply by division or fission, and by spore formation. The micrococcus develops by transverse division. If the division occurs through one plane, and is not complete, a diplococcus is formed, and if this process is continued streptococci, or the chain organisms, are produced. If the division is through irregular planes and complete the grouping is that of the staphylococci, which has been compared to a bunch of grapes. If the division is through regular planes and not complete a zooglia mass is the result. If the development is through two planes and at right angles four organisms are produced and the grouping is that of a micrococcus tetragenus (Fig. 81). The spirillum develops by transverse division.

If the organisms are spore-bearing, a highly refractive body makes appearance at the center of the organism or at one of its poles. The mic organisms may then disappear, setting the spore free. The spores repres the resting stage of the micro-organisms and show great resistance to refractive agents.

RAPIDITY OF DEVELOPMENT.

It is estimated that under favorable conditions a single micro-organi will develop into two at the end of the first hour, into four at the end of t second hour, into eight at the end of the third, so that during twenty-fo hours, eighteen and one-half million micro-organisms are produced from single germ. The conditions which are favorable to the growth of the organisms are a proper food supply with suitable light, moisture, temper ture, and gaseous surroundings.

They may be grown ordinarily upon artificial media. These media va somewhat with the different organisms; they must have a certain degr of moisture, as drying arrests the growth, although it does not destroy t germs. Temperature is also important. The putrefactive bacteria gro

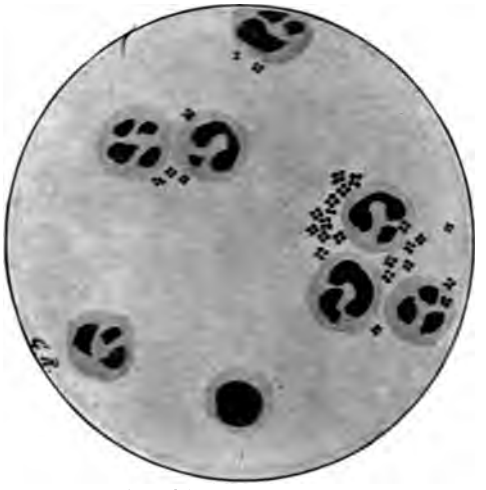


Fig. 81.—Micrococcus tetragenus.

best at about the normal room temperature, while the pathogenic and pyo genic germs grow well at the body temperature. Most bacteria becom dormant at extreme degrees of heat or cold. Many bacteria are very re sistant to dry heat; 212 degrees Fahrenheit will not destroy bacteria in les than one hour and a half. Freezing will stop the growth but does not kil the organism. The presence or absence of certain gases also influences th growth of bacteria. Some micro-organisms grow best in the presence o oxygen. These were termed by Pasteur aërobic bacteria. Others grow bes when oxygen is not present, and these are termed anaërobic. A faculativ aërobic organism is one that can grow in the presence or absence o oxygen.

Bacteria have received various names depending largely upon the prod ucts of their growth. Those organisms which produce specific disease ar

known as *pathogenic;* those whose growth results in pus-formation are known as *pyogenic;* those which are capable of carrying out their complete existence in some animal are known as *parasites,* while those that may develop in either dead or living animal matter are known as *saprophytes.*

PRODUCTS OF BACTERIAL GROWTH.

It is known that bacteria in their growth elaborate certain poisons. It is thought probable that these substances are produced in part from albuminous matter in which the bacteria develop. They are also produced by the metabolic activities of the germs.

There are several poisons which are produced by the activities of bacteria within the tissues. Among these are the *ptomains,* which are crystallizable alkaloidal bodies, originating from the bacterial decomposition of dead animal matter; *toxins,* which are poisonous substances secreted by the bacteria or contained in the bodies of dead or living organisms; and *toxalbumins,* which are non-crystallizable bodies not intimately associated with the protoplasm of the bacterial cells. It is to these various poisonous substances that the bacteria owe their disease-producing function.

PROTECTION OF THE SYSTEM.

The leukocytes and connective tissue cells are active in taking up the germs into themselves and destroying or sequestering them. Several antidotal bodies are present in the blood serum. These are called *alexins.* They are supposed to be in part the product of the secretions of the leukocytes which are active in the inflamed area. Bodies appearing during ordinary infection are known as *anti-bodies* or *antitoxins.* Another class which appears during the infection and which has the power of resisting the motion in the motile micro-organisms are the *agglutinins.* It is thought that all of these substances are proteids, but their exact nature has not been determined.

PYOGENIC BACTERIA.

Under favorable conditions these germs cause wound infection and pus formation. They are practically omnipresent as they are found in the air, water, soil, upon the surface of the body, under the finger nails, in our clothing, and upon everything that is exposed to the air, as well as in many of the canals and hollow organs of the body. In every wound to which these organisms gain an entrance pus-formation is possible. A number of conditions, however, are essential in order that pus-formation occur. Among these are suitable nourishment, light, heat and moisture, a sufficient number of germs, or those which are actively virulent, and a susceptible host. Some persons are practically immune, while others are very susceptible to infection. It is probably true that most wounds are not germ-free, and yet they heal by first intention without signs of active infection. This is because the conditions are not suitable for the growth and multiplication of the organism, or because they are not present in sufficient numbers or have not sufficient virulence. The pyogenic micro-organisms are the opprobrium of the surgeon's art, and probably are the cause of more care, anxiety, failures, and even deaths in his operative work than all the other conditions combined.

Great progress has been made in this connection in the technic for an during operations, as well as in the treatment of wounds, so that, at th present time, wound infection instead of being the rule may be rendered rare exception. But very much remains to be accomplished before surgery in so far as infection is concerned, will be absolutely satisfactory.

In the family of pyogenic germs the staphylococcic are among the mos important. They have been recognized as being a causative factor in th production of suppuration for a quarter of a century, or since the studie of Oyston, Krause, Rosenbach and Passet. The cocci are spherical, non motile, and non-spore producing organisms.

STAPHYLOCOCCUS PYOGENES AUREUS.

Among the most important organisms in this family is the staphylococcus pyogenes aureus. This is also one of the most frequent pus producing germs. It measures from .7 to .87 micro-millimeters in diameter. It multiplies by transverse division through more than one plane, producing a grouping which has been compared to a bunch of grapes. In its growth it coagulates milk and produces a golden-colored pigment. It is aërobic (Fig. 82).

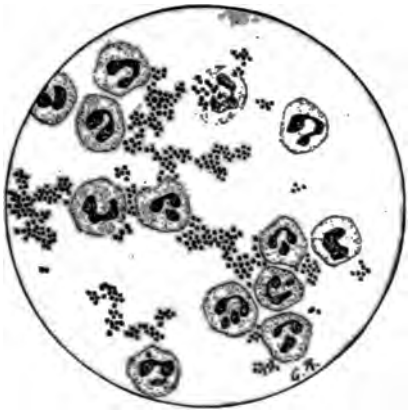


Fig. 82.—Staphylococcus pyogenes aureus.

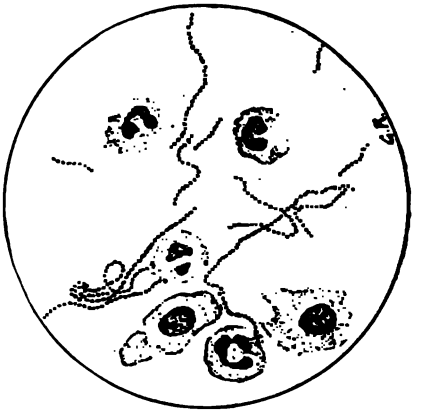


Fig. 83.—Streptococcus pyogenes.

STAPHYLOCOCCUS PYOGENES ALBUS.

This is also a pus producing organism, closely allied to the aureus but not so frequently encountered nor so virulent. It has a peptonizing action, coagulates milk, but does not produce a pigment. It frequently inhabits the superficial layers of the skin.

STAPHYLOCOCCUS PYOGENES CITREUS.

This germ liquefies gelatine and produces in its growth a lemon-colored pigment. When in considerable quantities and under favorable circumstances it produces pus.

Other micrococci, but of less importance, are the ***staphylococcus cereus albus*** and *staphylococcus cereus flavus*. The latter also produces a yellow

The *staphylococcus epidermidis albus* inhabits the skin and is found i the hair follicles, sweat, and sebaceous glands. This germ is now though to be the same as the staphylococcus pyogenes albus.

The staphylococci infect wounds and usually produce a circumscribe suppurative process. In the skin they produce pustular acne, furuncles, an carbuncles. They are often present, either alone or associated with othe organisms, in mucous and serous inflammations. They are usually the activ agents in acute periostitis, osteo-myelitis, and endocarditis. Gaining a entrance to the lymph channels, they produce lymphangitis, and, carried t the lymphatic glands, a lymphadenitis with or without suppuration. Enter ing the blood they may produce septicemia, or, when carried with infecte emboli to different parts of the body, pyemia.

STREPTOCOCCI.

These bacterial organisms vary somewhat in size and arrangement They measure about one micro-millimeter in diameter. The variations however, are seemingly not important, and the organisms may be considere under the head of the streptococcus pyogenes. This organism, when grow on culture media, appears in the form of chains, which is due to the divisio of the cocci in a plane at right angles to the chain. Various branches ma be produced like the limbs of a tree by a change in the angle of division In the growth of the cocci there is an absence of enzyme, and they may o may not coagulate milk.

The streptococcus pyogenes is one of the most virulent of the pyogenic organisms, and is usually present in all spreading inflammations. They may occur in pure culture, but usually are associated with other pyogenic organisms. They are usually present in cases of rapidly-spreading cellulitis or phlegmonous inflammation, and in erysipelas and septicemia. They are also often present in angina, synovitis, osteomyelitis, and peritonitis There has been considerable discussion as to whether the streptococcus o erysipelas (Fehleisen) and that of spreading suppurative cellulitis are on and the same organism. It is held by many pathologists and bacteriologist that the difference in the action of these germs is due to the mode of thei entrance into the system, and perhaps more especially to the degree o virulence. Thus it has been shown that the streptococcus which at one tim produced an abscess, may have its virulence so exalted as to produce erysipelas; and that the erysipelatous organism may be so changed and its virulenc reduced as to be an ordinary pus producer. It may be true that the difference of action is due either to the mode of infection, the result of environment, or the virulence of the organism, but every surgeon knows that erysipelas is seemingly highly contagious, while suppurative processes due t streptococcic infection are not.

These micro-organisms, like the staphylococci, may lie dormant in th residue of an abscess or be sequestered in old osteomyelitic lesions for years and then, as the result of some injury, become active and produce a new and acute infection (Fig. 83).

BACILLUS COLI COMMUNIS.

This organism is present under normal conditions in the small intestine of man. In pathological conditions it is a pus producing germ. Morpho

logically it is a short, thick, motile rod having numerous flagella. The organism, however, is subject to many variations, and in culture media not unlike the typhoid bacillus. It is thought to aid digestion and be a factor in the production of gas. The organism produces an acid fermentation in sugar, bouillon, and gelatine; curdles milk, forms indol, and produces gas. It is found in a great many of the suppurative processes in connection with the intestinal canal. It is often present in pure culture in appendiceal abscesses, in gall-stone inflammation, and in peritonitis. It is often an active factor in cystitis, pyelitis, and in abscesses of the kidney. It may also be a factor in endocarditis and pleurisy. In the intestinal canal it ordinarily has a low degree of virulence, but when grown on culture media its virulence is much increased (Fig. 84).

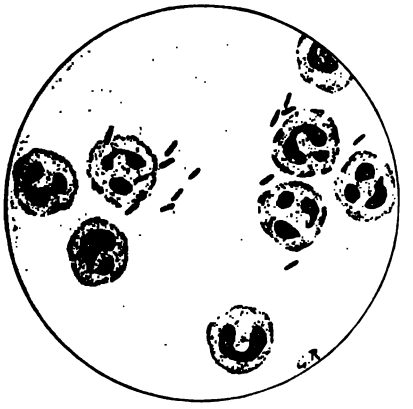


Fig. 84.—Bacillus coli communis.

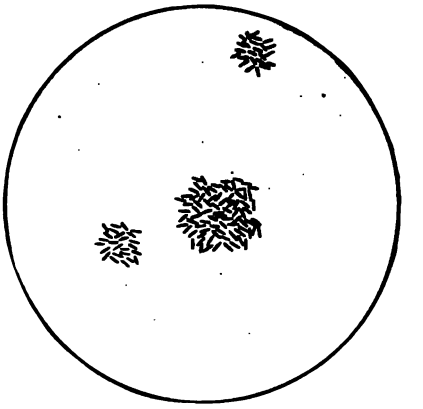


Fig. 85.—Bacillus pyocyaneus.

BACILLUS PYOCYANEUS.

This organism usually occurs in the form of minute separate rods, although two or more may be attached forming a long thread. There are also irregular and globular forms. The germs are actively motile and each has a single terminal flagellum. They coagulate milk and liquefy gelatine. They are often found in indolent suppurative processes, where healing is practically at a stand still. Their chief macroscopic characteristic is the production of blue or green pigment—pyocyanine. This pigment is carried off from the wound by the purulent discharge and imparts its coloring matter to the dressings, especially those which come in contact with the air. This bacillus has also been found, either alone or in association with other organisms, in suppurative processes of the middle ear, in the cranial sinuses, in angina, bronchitis, broncho-pneumonia, pleurisy, pericarditis, endocarditis, appendicitis, peritonitis, synovitis, and pyelonephritis. It may be an etiological factor in septicemia. It is supposed that the phenomenon of infection is due to a toxin (Fig. 85).

THE BACTERIA OF SPECIFIC DISEASES.

BACILLUS OF ANTHRAX.

This bacillus produces, in man, malignant pustule or wool-sorter's disease, and in animals, anthrax. It was discovered by Davine in 1850, and has

been called the key-stone of the arch of bacteriology. It is a large bacillus having a capsule, in suitable media, and measures from 3 to 6 micro-millimeters in length, and 1.5 micro-millimeters in width. In the resting state, but never in the host, spores are formed in the center of the rod and appear as bright, crystalline bodies. The bacillus is found in garden soil, which seems to be its natural habitat. It is also found on blades of grass and on shrubs, and from these it is conveyed to cattle and sheep during grazing. The disease may be conveyed to man through garden soil, or through any of the tissues of a living or dead animal which has been infected. Infection in man occurs through abrasions upon the skin, and internally through inhalations of dust to the lungs, and by infected food to the gastro-intestinal canal (Fig. 86).

BACILLUS OF TETANUS.

This is an anaërobic bacillus found in the superficial layers of garden soil. It was carefully studied by Nicolaier and Kitasato in 1884 to 1889.

Fig. 86.—Bacillus of anthrax

It is a slender, straight bacillus with rounded ends and, when not forming spores, grows out into long filaments. Spore formation occurs at one end of the bacillus, producing a drum-stick shape. Not only the bacillus, but also its spores, are found in the soil, and both are extremely tenacious of life. Infection is usually produced in man through punctured wounds. These may be caused by slivers of wood or nails, which carry the bacilli from the surface soil into the subcutaneous tissues. The germs after gaining an entrance to the tissues multiply and elaborate virulent toxins. This germ is an obligate anaërobe. The great danger of deep punctured wounds lies in the fact that the wound heals over, sealing up the organism within it, and the other aërobic, pus-cocci, which are introduced at the same time, use up the free oxygen, leaving thus an anaerobic condition favorable for the development of the tetanus bacillus (Fig. 87).

BACILLUS OF MALIGNANT EDEMA.

(See Fig. 103, page 119.)

This is a spore producing, anaërobic bacillus found in garden soil and in putrefying animal fluids. It was first described by Pasteur in 1877 under the name of *Vibrion septique*. Later, it was studied and described by Koch

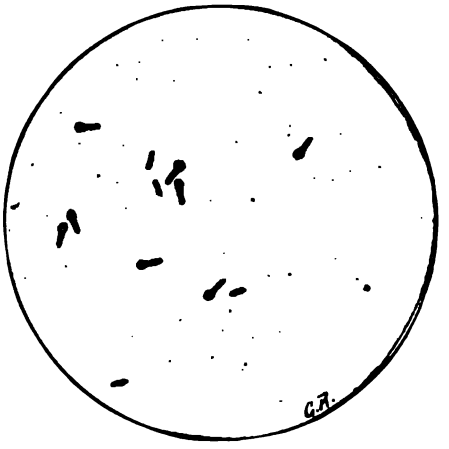


Fig. 87.—Bacillus of tetanus.

and given the name of the bacillus of malignant edema. It is a comparatively large organism, slightly thinner than the anthrax bacillus, with its oval spore placed at the center of the rod. The spore, which is slightly thicker

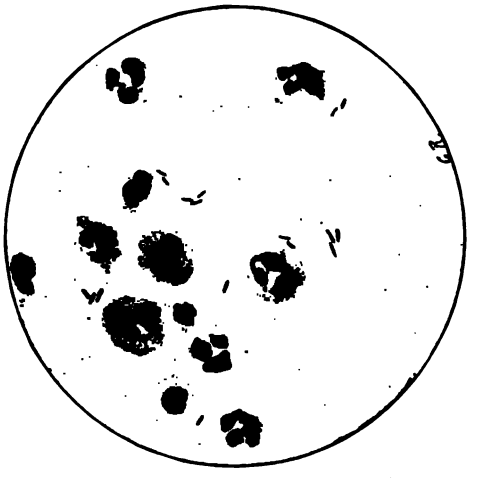


Fig. 88.—Bacillus of tuberculosis.

than the diameter of the rod, expands it somewhat. The organism occurs in the tissues and in culture media as single rods or as long filaments. These may be uniform throughout or segmented at irregular intervals. It is one of the motile bacilli and has several lateral flagella. After inoculation of a wound with these germs, there occurs a rapidly spreading, bloody edema

with necrosis of the adjacent tissues. There seems to be a close family relationship between this micro-organism and the gas-bacillus of Welch and Nuttall. When the two are associated in a wound, or after inoculation with garden soil, a rapidly spreading, gangrenous empysema occurs. It was pointed out by Park, however, that when pure cultures of the so-called bacillus of malignant edema are injected, emphysema and gangrene are absent. It is probably true that although there is a close family relationship between the bacillus of malignant edema and the gas-bacillus, they are nevertheless quite different, in that the bacillus of malignant edema is motile and spore bearing, and does not produce gas or gangrene when injected into the tissues. The gas-bacillus is not motile and does produce gas and gangrene when injected subcutaneously.

BACILLUS OF TUBERCULOSIS.

Koch announced the discovery of the tubercle bacillus in 1882. It is a slightly curved rod, usually of uniform thickness, occasionally, however, slight swellings are observed at the extremities. The organisms are of slow growth. Two or more bacilli may be attached by their ends, producing long filaments. In the tissues the bacilli occur singly, in twos or in small clusters. The tubercle bacilli, when multiplying within the tissues, produce certain well-recognized lesions.

Infection may occur through any of the mucous membranes, such as the gastro-intestinal canal, respiratory and genital organs, and through the skin. Aside from pulmonary tuberculosis the tubercle bacilli may produce such surgical affections as abscess of the lungs, pleurisy, peritonitis, ulceration of the bowels, infection of the genito-urinary tract, skin, joints, tendon-sheaths, and bones (Fig. 88).

TYPHOID BACILLUS.

The typhoid bacillus usually appears as short, plump rods, as filaments or as spherical bodies. They possess many long, wavy flagella, which are attached along their sides and ends. The organism is actively motile. In culture media the colonies appear finely granular and in old cultures the protoplasm does not stain well, giving the appearance of vacuolation. This condition has been mistaken by some for spore formation. There has been a good deal of discussion in regard to the relationship between the typhoid and colon bacillus. In many ways they are closely related. The typhoid bacillus is differentiated in part from the colon bacillus by the fact that their flagella are more numerous, longer, and wavy. The organisms grow slower in artificial media. They do not produce gas in gelatine shake-cultures, do not produce indol, do not coagulate milk, and they become agglutinated in the serum of typhoid fever cases. The typhoid bacillus is at times an etiological factor in surgical infections, such as abscesses in the mesenteric glands, in the spleen, liver, and bone. It is not infrequently the cause of cholecystitis, pleurisy, arthritis, subcutaneous abscesses, orchitis, and epididymitis.

GONOCOCCUS.

This organism, which is the causative factor of gonorrhea, was discovered by Neisser in 1879. It is a small coccus which occurs singly, in pairs,

and in fours. When occuring in pairs the ends are often slightly flattened or concave, so that between them there may be a slight oval interval. Nothing is known of the saprophytic condition of the organism, as it has never been found in animals outside of the human body. It is readily demonstrated in acute affections. Its chief characteristic is that it is found in heaps within the protoplasm of the polynuclear leukocytes. The leukocytes are at times seemingly filled with organisms. They are very numerous in acute cases, and are also found clinging to degenerated epithelial cells. In chronic affections it may be difficult to demonstrate them. They are not only the causative factor of gonorrhea, but also of ophthalmia neonatorum and often cause arthritis, tenosynovitis, salpingitis, acute and chronic cystitis, local peritonitis, pleuritis, myocarditis, and pyonephrosis (Fig. 89).

THE SPIROCHETA PALLIDA IN SYPHILIS.

In May, 1905, Schaudinn and Hoffman announced the discovery of a new spiral organism in syphilitic lesions, which they termed the spirocheta pallida. The organism is described as being from 4 to 10 microns in length, the average being about 7, or about that of the red blood corpuscle. In width, it is from an unmeasurable thinness to about 0.5 micron. It has from

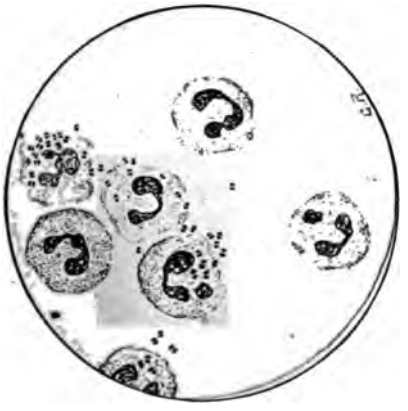


Fig. 89.—Gonococcus.

Fig. 90.—Spirocheta pallida of syphilis.

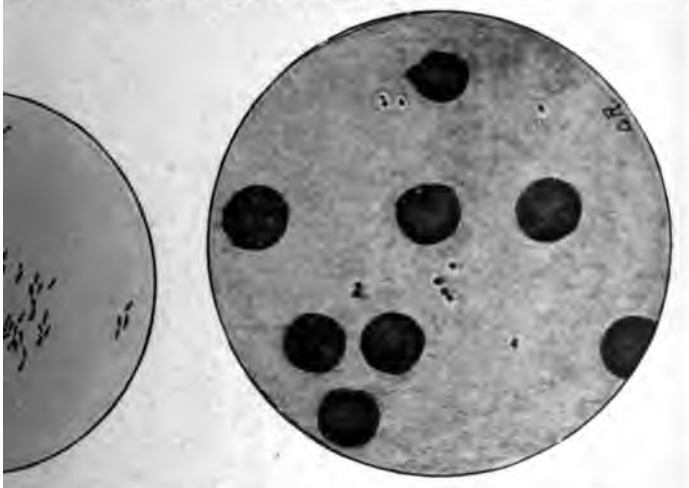
three to twelve curves. These are sharp and regular, resembling the curves of a cork-screw. The organism has pointed ends, and is very actively motile. Its motility is due to forward and backward rotations on its long axis and to bendings of the body or, according to Schaudinn, to flagella, two of which he has discovered on one end and one on the other. The organism has been stained with Giemsa's azure eosin. It takes the stain faintly after from one to twenty-four hours' exposure. In consequence of its extreme thinness and faintly staining properties, it is often very difficult to find. It must be differentiated from the spirocheta refringens, which is found in syphilitic and non-syphilitic lesions, but which is longer, thicker, has less definite curves, and stains better than the syphilitic spirocheta.

pallida has been found with special frequency in the ıry syphilitic lesions. It has also been found in gummata, nonstrated with any degree of certainty in non-syphilitic e thinness and poor staining qualities, coupled with the heta refringens is found in syphilitic and non-syphilitic : at times difficult to demonstrate the pallida and again for the spirocheta refringens.

ɔt at this time be positively stated that the spirocheta ical factor in syphilis, the investigations which have thus a large number of bacteriologists would seem to point s direction (Fig. 90).

LLUS OF GLANDERS: BACILLUS MALLEI.

was discovered by Löffler and Schütz in 1882. The m of straight or slightly curved rods with rounded ends.



glanders—bacillus mallei. Fig. 92.—Bacillus lanceolatus.

: same length as the tubercle bacilli, but thicker. In cul- irregular forms are seen and sometimes a network of ɔwing side branching. This has led some observers to ism with the ray fungus, or to hold that it belongs to a ly. The organism is non-motile and probably non-spore d in horses, where it affects principally the nasal mucous ıg a growth of granulation tissue in the form of nodes ɔwn into ill-conditioned ulcers. From these ulcers there ıus discharge, which contains the germs of the disease. nmune, but infection has occurred through abrasions ɔse (Fig. 91).

NCEOLATUS OR FRAENKEL'S PNEUMOCOCCUS.

ıs first identified in the human saliva by Sternberg, in be the causative factor in lobar-pneumonia by n in 1886. It is a small, oval, lance-shaped coccus,

which usually occurs in pairs, but may occur singly or in chains of eight or ten. It has a distinct capsule. It is thought by some observers that the diplococcus is closely related to the streptococcus pyogenes. It has not been found in saprophytic conditions, but occurs in discharges from the nose, throat, tonsils, and nasal mucous membranes. A fatal septicemia may be caused in rabbits and mice by an injection of the diplococcus. In man, beside being the etiological factor in pneumonia, it is shown to produce such surgical affections as pleurisy, peritonitis, synovitis with effusion, periostitis, adenitis, and appendicitis (Fig. 92).

ACTINOMYCOSIS BOVIS—ACTINOMYCOSIS HOMINIS.

There are a number of ray fungi which are pathogenic. This particular fungus is made up of unicellular, branching mycelial threads. The separate

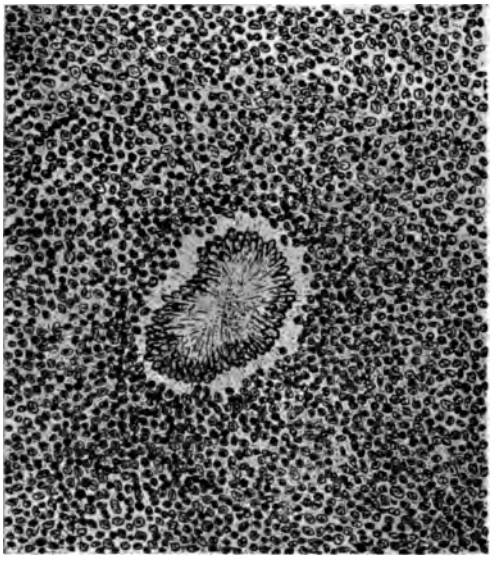


Fig. 93.—Actinomycosis bovis—actinomycosis hominis.

threads are quite straight, have a transparent membrane, and a homogeneous structure. At times they are spore-forming. The organism was first recognized by Lebert, in 1857, and the disease, as it occurs in cattle and known as lumpy jaw, was first described by Bollinger in 1877. The disease as it occurs in man was first recognized by Israel in 1882. According to Pasteur the fungus is found upon blades of grass and upon bearded cereals such as barley, rye, and wheat. The fungus seems endemic in certain regions and frequently infects man through slight wounds in the mucous membrane of the mouth. These wounds are presumably caused by blades of grass or beards of grain. The fungus occurs in the form of threads which radiate from a central area like a rosette. When the organism becomes implanted beneath the skin or mucous membrane, most frequently about the lower jaw, it produces a chronic inflammatory process with induration of the skin

and subcutaneous tissues and the formation of granulation tissue. The process is chronic and progressive (Fig. 93).

BLASTOMYCETES. OR YEAST FUNGUS.

This organism appears in the form of a round or oval cell having a definite wall. The cell is made up of protoplasm in which numerous vacuoles are occasionally to be seen. It multiplies by budding and by spore formation, and occurs as isolated cells and in the form of mycelial threads. When the organisms find lodgement in the skin they produce nodules which are made up of granulation tissue having giant cells. The nodules frequently break down into chronic ulcers. The germs, occurring singly or in chains, are found both within and between the cells of the nodule. The nodular tumors and ulcerative processes run a chronic course and are frequently mistaken for sarcomatous growths or epitheliomatous ulcers. Metastatic processes in internal organs are occasionally seen, in which the fungus may be demonstrated (Fig. 94).

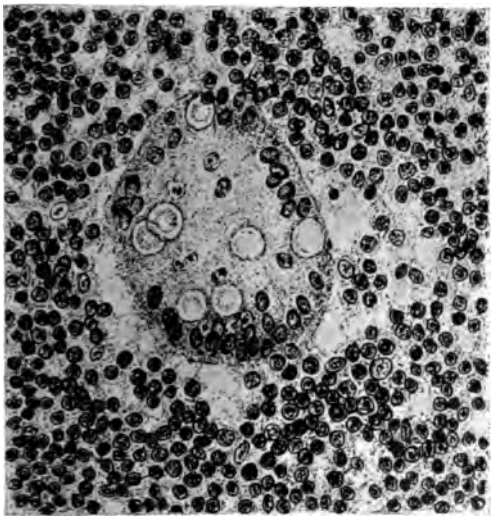


Fig. 94.—Blastomycetes or yeast fungus.

PROTEUS VULGARIS OF HAUSER.

This bacillus may be taken as the representative of a group of organisms which have certain common characteristics, in that they are saprophytic bacteria or the organisms producing putrefaction in dead animal and vegetable matter.

The proteus vulgaris is from 1.25 to 3.75 micromillimeters in length and about .6 of a micromillimeter in width. It has rounded ends and is commonly seen in pairs, although it may grow out into long, flexible filaments or assume a spiral form. The bacillus is actively motile and is possessed of a number of flagella arranged radiately about the cell. These bacilli liquefy gelatine, coagulate milk, and digest casein. Indol and phenol

are formed and sugar is fermented. During the peptonization of gelatine and blood serum putrefactive odors are evolved.

The proteus group of organisms not only cause disease by the contamination of food stuffs, but they are also, either alone or in association with other organisms, the causative factors of many surgical affections. In many infected wounds which show a gangrenous or putrefactive tendency, they have been found associated with other organisms. In brain abscesses, gangrene of the lungs, gangrenous peritonitis, ulcerative endometritis, gangrenous pleurisy, and in the pus of osteomyelitis, they have been found associated with the pyogenic organisms. They have been the sole causative factor in some cases of peritonitis, appendicitis, cystitis, pyelonephritis, and in abscesses of the mammary gland, ovary, and liver.

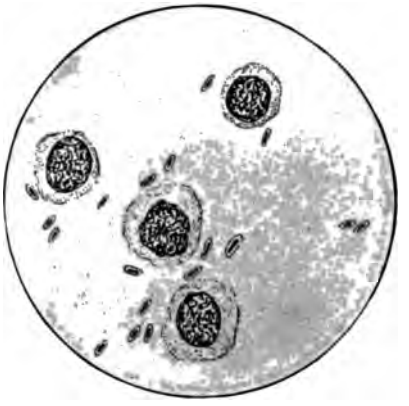


Fig. 95.—Bacillus of rhinoscleroma.

BACILLUS AEROGENES CAPSULATUS.

The gas-bacillus of Welch and Nuttall. This is an anaërobic, non-motile and usually non-spore producing bacillus which is found in garden soil and in the intestinal canal of man. In size it resembles the anthrax bacillus and occurs in pairs, clumps, or short chains. It ferments glucose, saccharose and lactose with the evolvement of hydrogen.

When these organisms occur in a wound under favorable circumstances, a rapidly spreading gangrene with emphysema is produced. Gas-bubbles are formed and gangrene occurs in the skin and subcutaneous tissues. There is a hemorrhagic exudate with a few leukocytes. The wound is in a putrescent condition. Infection may also occur within the internal organs, such as the uterine cavity, gastro-intestinal tract, gall-bladder, respiratory and urinary tract.

BACILLUS CAPSULATUS MUCOSUS. OR PNEUMOBACILLUS OF FRIEDLANDER.

This germ may be taken as the representative of a group of organisms which are closely allied, although they vary in their morphological characteristics. They are non-motile, non-spore-forming, encapsulated bacilli. Friedländer's bacilli occur as short, thick rods, with blunt, round ends, and

have a definite capsule. They are capable of producing active fermentation. The bacillus has been found in the dust of the air, in canal water, and in the nose, mouth, trachea, and intestines of healthy individuals. The capsulated bacillus is frequently the causative factor of pneumonia, pleurisy, endocarditis, bronchitis, meningitis, abscess of the liver and lungs, and rhinoscleroma.

BACILLUS OF RHINOSCLEROMA.

In the nodules of rhinoscleroma are to be found large, round cells—the cells of Mikulicz. The protoplasm in these cells contains a gelatinous material in which are to be found short, oval, encapsulated bacilli. These organisms were discovered by Frisch and are supposed to be the causative factor in the disease. They have much in common with Friedländer's bacillus, and are thought to be either one and the same organism or a different member of the same group of organisms (Fig. 95).

CHAPTER V.

IMMUNITY AND INFLAMMATION.

Immunity is exemption from, or resistance to, disease. Immunity may be said to be the ability of an organism to defend itself against harmful influences. Immunity has been described as a condition in which an individual is protected from certain noxious materials which would be harmful to other individuals. Immunity may not be absolute and permanent, but more often is only partial and transient.

We are constantly exposed to the pyogenic and pathogenic micro-organisms, for they are in the air we breathe, in the water we drink, in the soil upon which we tread, upon the surface of our bodies; the fact that we withal escape infection shows that there is some influence which gives us protection.

Immunity has been divided into *histogenic* and *hematogenic*. In histogenic the cells are either not susceptible to noxious influences or are able to combat them; while in hematogenic there are certain substances in the blood, such as antitoxins, which counteract the noxious substances.

NATURAL IMMUNITY.—It is understood from this that an animal, from birth, is insusceptible to the action of certain noxious influences. Thus the lower animals are immune to gonorrhea, syphilis, typhoid fever, malaria, and many other contagious and infectious diseases. The venom of a rattlesnake is very poisonous to man, while a hedge-hog is immune to any ordinary dose of venom.

Race and age are often important factors in immunity. The inhabitants of tropical countries are often immune to malaria and do not suffer from the disease, although the plasmodium of malaria may be present in their blood. Children are comparatively immune to typhoid, while adults are seldom attacked by measles or scarlet fever. Many individuals show decided immunity to infectious diseases, others to pyogenic infection. Some individuals are very susceptible to pyogenic infection. The degree of natural immunity is, however, affected by many conditions. Anything which lowers the vitality and diminishes the resistance, or interferes with the health and well-being of the individual lessens the degree of his immunity. Thus fevers, hemorrhage, infection, starvation, bad air, and exposure to cold and wet are some of the influences which have a marked effect in lessening immunity.

Local immunity to pyogenic infection is lessened by local anemia, by injury, chemical irritants, and by cold.

ACQUIRED IMMUNITY.—This condition is the result of some change which has occurred in the individual since birth. Syphilis, typhoid fever, yellow fever, and the exanthematous diseases usually afford immunity

against a subsequent attack. A degree of immunity is acquired by the use of certain drugs. An individual habituated to the use of cocaine, morphine, and arsenic is able to take with impunity an amount which would prove fatal to the ordinary person. The same is true of alcohol.

A mother who during pregnancy suffers an attack of small-pox usually confers immunity on the child against the disease.

INTENTIONAL ARTIFICIAL IMMUNITY.—The practice of immunizing persons against diseases is very frequently made use of at the present time. Vaccination, introduced by Jenner and as practised at the present time, affords immunity against small-pox. Pasteur was able by inoculating chicken-cholera bacilli, whose virulence had been reduced, to afford immunity against this disease. He was also able to prevent hydrophobia in persons who had been bitten by rabid dogs, by injecting emulsions made from the spinal cords of infected rabbits. Immunity may be obtained from anthrax and cholera by inoculating weakened cultures of the organisms of these disease.

ANTITOXIC SERA FOR THE CURE OF DISEASE.

There have been a number of these sera prepared. The one for diphtheria gives the greatest satisfaction and is now in general use. The sera for tetanus and snake poison are not so satisfactory. In the preparation of the antitoxic serum for diphtheria, the horse is usually made use of and is given, by injection, repeated and constantly increased doses of the toxins of the disease. The first injection produces fever and malaise, but with each injection a certain immunity is established so that the succeeding injections, although greater in quantity, produce less disturbance, until finally the animal is not affected by the toxins and becomes immune to the poison. During the immunizing process there appears in the blood of the animal a new protective body known as *antitoxin*.

Antitoxin has been described as a peculiar protective energy manifested by certain proteids contained in the blood-serum of animals which have been immunized. The blood-serum of these animals, when withdrawn and injected into other animals, will produce immunity. There are several anti-bodies which may appear in the blood-serum during forced immunization. If bacteria in living or dead cultures are injected, the blood-serum becomes bacteriolytic and is able to dissolve the specific micro-organisms of the disease. This effect is the result of a substance always present in the blood and known as *alexin* or lysin. Alexin, however, seems unable to act unless in the presence of another body, which is probably due solely to the immunizing process, and is known as an amboceptor or immune body. These cytotoxic sera, as they are called, have not as yet given practical results.

THEORIES OF IMMUNITY.

Three principal theories have been advanced as explaining the chief factors of immunity. One of these is the humoral theory, which attributes immunity to certain specific elements contained in the blood-serum. The second is the cellular theory, which attributes immunity to the action of the phagocytes. The third is the side-chain theory of Ehrlich.

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When a toxin enters the system of a susceptible individual the haptophores of the toxin unite with the receptors of the cell, and the nutrition of the cell is interfered with or arrested, because the receptors, through which the cell receives its nutrition, is already occupied. At the same time the toxophores, or cell-poisoning principles, are brought into action in consequence of the union of their haptophores with the receptors, and the cells are injured or destroyed. If the toxin introduced is less than a lethal dose, all of the receptors will not be shut off by union with the haptophores, and the toxophore, while injuring the cell, will not destroy it, but stimulate it

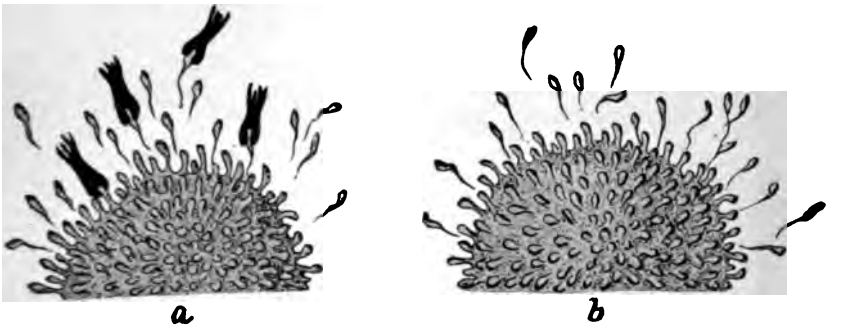

Fig. 97.—a and b shows liberated receptors and haptophores.

to form more receptors. A greater number of receptors may then be formed than can unite with the haptophores or can remain united with the cell, consequently they are detached and float off into the blood as antitoxins. These receptors or antitoxins, while floating in the blood, are capable of uniting with the haptophores of a toxin, and thus they protect the cells and render the individual immune from the specific disease under stimulation of which they have developed (Fig. 96).

According to the side-chain theory of Ehrlich the anti-bodies in the blood are due to the presence of the receptors. Natural immunity is ex-

Fig. 98.—Shows indirect union by means of the intermediate body or amboceptor.

plained by the absence of specific receptors to combine with the haptophores of the particular toxin. Without this union, the cells cannot be poisoned nor specific disease produced. Acquired immunity is explained by the liberation in the blood of an increased number of receptors. These are capable of uniting with the haptophores of some specific toxin, thus preventing cell-poisoning and the specific disease (Fig. 97).

THE THEORIES OF IMMUNITY AS AFFECTING THERAPEUTICS.

It must be borne in mind that the bacterial toxins cause disease and nc the bacteria themselves. There are two separate and definite classes o bacterial toxins (Fig. 98).

(1) The extra-cellular toxins which are a secretion of the bacteri: during their growth. These toxins are capable of producing disease oı death. Representatives of this class are the toxins of diphtheria and tetanus. In the treatment of these diseases antitoxic sera are administerec by injection. The antitoxins of the serum unite with the toxins of these diseases which they neutralize.

(2) The intra-cellular or endo-toxins. These toxins are a part of the bacterial substance and are set free only upon the death of the organism. Examples of the bacteria which liberate upon their destruction the intracellular or endotoxins are the comma bacillus of cholera, and the staphylococcus and streptococcus organisms. These bacteria may enter the system and be destroyed, but they are in such small numbers that the amount of toxins liberated is too small to produce any special disturbance. Again these bacteria may find an entrance into some localized area of the system and, being destroyed in sufficient numbers, will liberate their toxins and cause a localized inflammation. In the more aggravated cases they gain an entrance to the general circulation and, being destroyed in sufficient numbers so as to liberate large quantities of toxins, will cause a general infection or septicemia, or as it is termed, bacteremia.

The antitoxic sera for these infections have not proven successfu' as therapeutic agents. This has been explained by Ehrlich as follows: (The Theory of the Lysins:) In pyogenic infection no antitoxins are formed against the intracellular toxins, but there is a vigorous effort put forward by the system to destroy the germs. Normal blood-serum is often strongly bacteriolytic for some species of bacteria. This action is due to two distinct principles, the intermediate body and the complement.

The intermediate body is very stable and has an affinity for certain albumin molecules forming part of the protoplasm of the bacillus, and is capable of entering into chemical combination with them. The complements then enter into combination with the intermediate body and, being enzymes, are able to dissolve the albumin molecules of the bacillus and to destroy the bacillus itself. The complements exist in enormous numbers in the blood and in fresh serum, but on keeping a serum for a few days, or on heating it to 55 degrees C., they break up and disappear. The intermediate bodies being more stable are able to attach themselves to the bacilli, but in the absence of the complements, they can exert no harmful influence upon them, consequently these sera when kept or heated for a short time become inactive because the complements have disappeared. In the blood of an immunized animal there are great quantities of both the intermediate bodies and complements, and as the result of these such an animal is able to dispose of enormous numbers of bacilli to which it has been immunized.

INFLAMMATION.

Inflammation may be defined as the sequence of an injury to living tissue. It matters not whether this injury be mechanical, thermal, chemical, or bacterial. In an inflammation all of the tissues within the injured area take part in the process. This process is purposive, protective, and reparative, but not always wholly beneficial. The seeming intent of an inflammation is to protect the injured and adjacent tissues against further harmful influences, to remove dead tissue and to repair the injury done. In cases of microbic infection the intent apparently is to remove or destroy the micro-organisms, to digest and remove dead tissue, and to repair the injured structures. Nature, however, is not always able to accomplish these results, and in the attempt to do so may destroy the life of the individual.

ACTIVE HYPEREMIA.—One of the first processes in an inflammation is an active hyperemia in which the arteries, capillaries, and venules of the affected part dilate. The blood current at the same time becomes more

Fig. 99.—Mesentery of frog. Normal blood vessel.

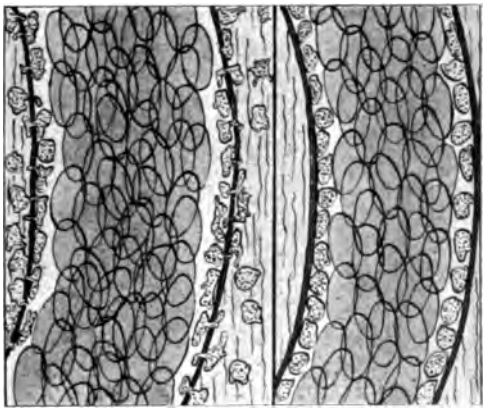

Fig. 100.—Showing vessel during hyperemia.

rapid and the blood corpuscles come to fill the lumen of the vessels. This active hyperemia, in which the blood vessels are dilated, the current more rapid, and the blood corpuscles fill the lumen of the vessels, is followed by a stage in which the blood stream becomes slower and the leukocytes, having a lessened specific gravity, lag behind the red cells and are seen to oscillate forward and backwards and finally to cling to the sides of the vessels. With the slowing, or stasis, of the current in the smaller vessels the leukocytes pass through the walls of the capillaries and venules into the adjacent tissues. At times when the process is very intense the red cells also escape through the walls of the vessels. Although the matter is somewhat in dispute, it is generally held that the escape of the leukocytes is, in part, an active process depending upon the inherent motility of the cells, the slowing of the blood-current and the changed condition in the walls of the vessels. It has been shown by Arnold and others that this emigration occurs through the cement substance which holds the endothelial cells to-

gether. The endothelial cells have the power of contraction and retractio thus increasing the size of the supposed openings, or stomata, between then Following the slowing of the blood-current and the dilatation of the vessel and coincident with the escape of the leukocytes, blood plasma passe through the walls of the capillaries into the adjacent tissues. The amoun and composition of this exudate varies greatly. In dense tissues there wi be but little, but in loose, vascular structures, as in subcutaneous tissue, th amount may be very considerable. It is richer in proteids than ordinar lymph and may contain fibrinous masses, or fibrinogen, and the neucleo albuminate of calcium. Fibrinogen and the neucleo-albuminate of calciu may unite outside of the vessel wall and produce fibrin. Fibrinogen and th calcium salts exist in the circulating blood, but the neucleo-proteid is derive

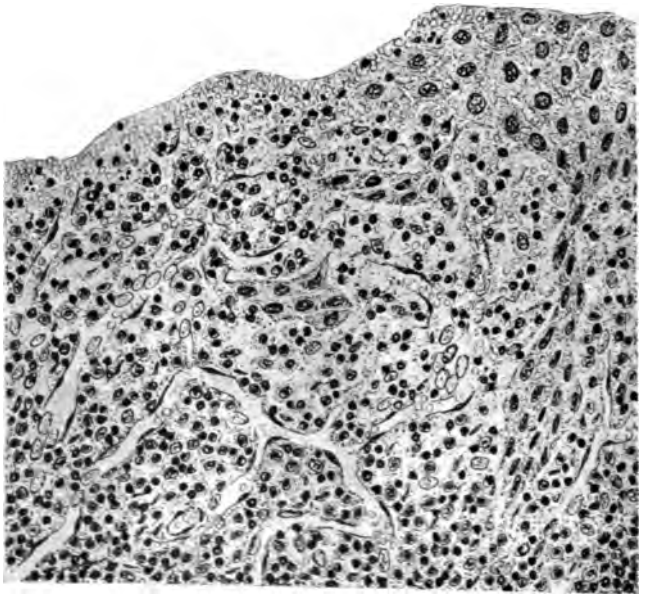

Fig. 101.—The formation of granulation tissue.

from the disintegration of the leukocytes and the blood plates. This inflammatory exudate may be serous, as often occurs in mild forms of inflammation affecting the serous membranes. The fluid in these cases contains no fibrin and but a few cells, corresponding in its composition to a transudate. The exudate may be sero-fibrinous or fibrinous, containing a mixture of serum and fibrin, or it may be almost wholly fibrinous. It may occur in tissue spaces upon serous, mucous and cutaneous surfaces. A hemorrhagic exudate in which there are a large number of red cells occurs in intense inflammatory conditions in which the vessel walls are much altered (Figs. 99, 100).

THE CHANGES IN THE FIXED TISSUE CELLS IN INFLAMMATION.—These are degenerative and reparative. Tissues that have been injured, no matter whether the injury be a severe traumatism, the result of extreme heat or

cold, the application of chemicals, or the action of bacteria, may undergo immediate necrosis, or the process may be one of degeneration. Necrosed tissue is gotten rid of by digestion, liquefaction, or absorption. To correct the defect caused by the destruction of tissue, the fixed connective tissue cells within the area immediately surrounding the injured tissues take on an active proliferation, producing what is known as formative or granulation tissue.

GRANULATION TISSUE.—This is composed, first, of small round cells with irregular nuclei—the leukocytes; second, large hyaline leukocytes—mononuclear; third, small lymphhocytes and plasma cells; fourth, cells of

Fig. 102.—The formation of capillaries.

variable size, oval, spindle-shaped and branching—the proliferating connective tissue cells; fifth, especially in tubercular inflammations, giant cells.

The only cells which are known to take an active part in the reproduction of tissue are the proliferating connective tissue cells. Metschnikoff, however, holds that the hyaline leukocytes may be converted into connective tissue cells (Fig. 101).

THE FORMATION OF BLOOD VESSELS.—With the production of a solid mass of granulation tissue, new capillaries are necessary for the purpose of nourishment. These are formed by the budding or sprouting of the endothelial cells of pre-existing capillaries. The protoplasm of one or more of these cells becomes swollen and throws out a bulbous mass having a long, ring extremity. At the same time a nucleus or nuclei appear within the

mass of protoplasm and new cells are formed. The tapering extremities of these cells unite with similar processes from other cells and other capillaries. In this manner a scaffolding of endothelial cells is constructed throughout the granulation tissue. This scaffolding, composed of protoplasmic cells, then becomes hollowed out or canalized producing capillaries connecting with pre-existing capillaries through which the circulation is established. Ziegler holds that capillaries may be built by the formative connective tissue cells, they giving off processes which join with like processes from the capillaries and these becoming canalized, form new vessels. The cells of these new capillaries are reinforced by the proliferation of their endothelial cells and by the apposition of formative cells from the adjacent tissues (Fig. 102).

THE PURPOSE AND IMPORTANCE OF THE INFLAMMATORY EXUDATE.—Nutall was one of the first to show that blood serum had a marked bactericidal effect. Attenuated anthrax bacilli placed in normal serum showed degeneration forms before they were taken up by the phagocytes. Afanassieff found that on placing virulent cultures of anthrax bacilli on healthy granulation tissue, a rapid destruction of the bacilli by the serum occurred. The exudate also irrigates the tissues and removes or dilutes the noxious substances. With our present knowledge it would seem as though in inflammation both the leukocytes and blood serum were active agents in protecting the system, by inhibiting or destroying the bacteria and their products as well as other harmful bodies.

THE INFLUENCE OF THE NERVOUS SYSTEM.—It is well known that the vitality of tissues, and consequently their power of resistance to injury, is greatly reduced by the withdrawal of the nerve-influence as in cases of paralysis. It has been shown experimentally by Samuel and Rogers that if the vaso-constrictor of the ear of the rabbit be divided and the ear subjected to a high degree of temperature, an acute inflammation will occur which proceeds rapidly to recovery. On the other hand, if the vaso-dilator is divided under the same conditions, stasis of the blood current and necrosis of tissue occurs. These experiments seem to show that an active hyperemia and a free exudate are necessary after an injury to preserve the tissues from necrosis.

PHAGOCYTOSIS.—This term is inseparably connected with the name of Metschnikoff. He has been the great advocate of the theory that the leukocytes were the active agents in protecting the tissues in infective inflammatory processes by ingesting and destroying the bacteria. There is probably now no question but that certain pathogenic and pyogenic bacteria, as well as other substances, exert a positive chemotaxis for the leukocytes. The leukocytes approach these foreign particles by virtue of this chemotaxis and their inherent motility, enclose them in their protoplasm and destroy them probably by a process of digestion. The cells which have this function are the polymorphonuclear leukocytes and large mononuclear hyaline cells. The endothelial cells and other fixed mesoblastic cells have this same property, but in a lesser degree. It has been shown by Metschnikoff, that the virulence of the bacteria plays an important rôle in chemotaxis and that when an attenuated culture of anthrax bacillus is injected into the ear of the rabbit, positive chemotaxis occurs. But when a virulent culture is injected, the leukocytes were repelled and even destroyed. Leukocytes also

not frequently ingest bacteria which they are unable to destroy. In fact, the bacteria after being ingested may destroy the leukocytes and thus set themselves free. Metschnikoff has observed certain bacteria perform active movements within the vacuoles of the leukocytes.

It has also been shown that the leukocytes have an extra-cellular action. in that they may secrete, or during their disintegration liberate, a strongly bactericidal substance. Löwit was able to extract a strongly bactericidal substance from the leukocytes. Vaughan and Kassel have extracted from blood plasma a nucleinic acid, a bactericidal product found only in nucleated cells.

THE RÔLE OF THE LEUKOCYTES IN INFLAMMATION.—The emigration of the leukocytes from the capillaries is an active process and is due at least in part to the motility of the cells and to positive chemotaxis. They are attracted to an inflamed area by the products of bacterial growth, by the products of disintegrating tissue and by other substances. Their function is, to some extent, bactericidal as they ingest and destroy some of the less virulent organisms. They probably also produce by secretion, or disintegration, a bactericidal substance. They carry away to lymph nodes and excretory organs the debris of broken-down tissue, and they are taken up by the formative cells to which they afford nourishment.

THE TERMINATION OF INFLAMMATION.—This will at least in part depend upon the cause, the condition of the system, the tissue affected, and the treatment. Inflammation due to a trauma, provided infection is prevented, never extends beyond the area injured, and if the injury is only slight the tissues soon return to their normal condition, the exudate is absorbed by the lymphatics and venules, the hyperemia and swelling disappear, and function is restored. In cases in which the inflammatory action is more intense, with destruction of tissue, the process takes longer and the result accomplished is not so perfect. In these cases the dead tissue is either removed by digestion, liquefaction, absorption and the action of the leukocytes, or it is sequestered. The defect caused by the death of tissue is corrected by the building of embryonal or formative tissue, which is later converted into fibrous or cicatricial tissue.

SUPPURATIVE INFLAMMATION.—This is an inflammation due to pyogenic infection and followed by suppuration, in which considerable destruction of tissue occurs. In these cases repair is both slow and imperfect because the infection must first be localized by the inflammatory exudate and the destroyed tissue replaced by new tissue, usually cicatricial tissue.

PRODUCTIVE INFLAMMATION.—This process is usually chronic and the new tissue may be regenerative, but produced in excess of that which was destroyed; or the new tissues may represent a real hypertrophy. Many of the productive inflammations are due to chronic infection, as in tuberculosis, syphilis, actinomycosis, glanders, rhinoscleroma, and certain blastomycetic processes. Others are apparently due to the stimulus of continued irritation as in some of the papillomata, the exostoses and osteophytes of bone; or they may be due to some constitutional disturbances or chemical substance, as in rheumatoid arthritis, chronic rheumatism, and gout. The new tissues in these cases have this in common, they are produced in ex-

cess, have a lowered vitality and are likely to fall into decay or degeneration. Perfect restoration of tissue is seldom accomplished.

GANGRENOUS INFLAMMATION.—Gangrene may occur as the result of an inflammatory process. In these cases it is due either to the virulence of the infection, the low vitality of the tissues, or to the arrest of the circulation. The latter may be caused by a trauma; or embolus by great swelling of the part; by the action of chemicals or by extreme degrees of heat or cold.

PHLEGMONOUS INFLAMMATION.—This is a rapidly spreading, inflammatory process implicating the skin and subcutaneous tissue and due to streptococcic or mixed infection. By some writers it is placed under the head of erysipelas, but I have chosen to place it among the inflammations, because it is always attended with suppuration, which is ordinarily foreign to an erysipelatous process. It is represented locally by a progressive swelling, the tissues being thickened, edematous, and the skin of a brownish color. The process extends rapidly up the limb, the infection following the fascial and muscular planes. A thin, ichorous pus is formed, with more or less necrosis of the subcutaneous tissue.

SEROUS INFLAMMATION.—By this is meant an inflammatory process implicating a serous membrane. These are the peritoneum, pleura, pericardium, and tunica vaginalis. With less anatomical restriction and for clinical purposes, the synovial membranes of joints, bursæ and tendon-sheaths may be included, as well as the membranes of the brain and spinal cord. In these inflammations the exudate may be serous, sero-fibrinous or plastic. The amount of a serous exudate may in a few hours or days be so large as to distend the sac inflamed. If the exudate is fibrinous or plastic the adjacent serous walls may be united or adhesions may form between various organs, binding them together.

STHENIC AND ASTHENIC INFLAMMATIONS.—A sthenic inflammation may be defined as one occurring in a young, vigorous individual in which the local symptoms are well marked. The constitutional symptoms are also pronounced. There is high fever, rapid pulse, pain, malaise, and perhaps mental disturbance.

In asthenic inflammation the conditions are reversed, the patient is weak, debilitated, and often old. The inflammatory reaction is mild and only slowly progressive. The swelling is not acute and the constitutional disturbance not severe.

HEMORRHAGIC INFLAMMATION.—This is an inflammatory process in which the red blood corpuscles in large numbers escape into the adjacent tissues. The condition is caused by a high degree of inflammatory reaction in which the hyperemia is intense and the subsequent stasis of the circulation pronounced. The process occurs in severe infections, in the old and enfeebled, in inflammations attended with cardiac and pulmonary disease, in scurvy, hemophilia, and in conditions in which the blood has lost much of its plasticity.

SYMPTOMS OF INFLAMMATION.

Celsus recognized the inflammatory process by four cardinal symptoms. These were heat, redness, swelling, and pain (*color, rubor, tumor,*

et dolor), to these a fifth has since been added, a disturbance or loss of function (*functio læsa*).

HEAT.—The temperature of the inflamed area is perceptibly increased. This is primarily due to the increased amount of blood going to the part, as Cohnheim has shown that twice as much blood returns from an inflamed area as from a corresponding healthy area. The heat is also increased in consequence of the active chemical and pathological changes going on in the inflamed tissue. It is claimed, however, that the heat of the inflamed area is never greater than that of the blood at the heart.

REDNESS.—The redness is due to the increased amount of arterial blood in the part. This, however, is a very variable quantity. Primarily, when the hyperemia is active and the part red, the color will disappear on pressure with the finger but it quickly returns. With the slowing of the blood current and a lessened oxygenation, the part assumes a dusky hue; at a still later period, if the primary hyperemia is of the hemorrhagic variety, the skin becomes yellowish in consequence of the disintegration of the red blood-cells and the changes in the hemoglobin.

SWELLING.—Swelling is due to the exudate, that is, to the escape of leukocytes and blood plasma into the interstices of the tissue. The degree of swelling will depend largely upon the amount of exudate and inversely upon the density of the tissues. In bone, cartilage, tendon, fibrous tissue, skin, and in the cornea, both the amount of exudate and the degree of swelling will be slight. In the later stages of acute inflammation, as well as in chronic inflammation, the swelling is due in part to the production of new tissue.

PAIN.—Pain is caused by the pressure of the exudate upon the nerve filaments. It may also be due to the increased amount of blood present in the part. Thus, in an inflammation of the hand, if it is allowed to hang down the pain is greatly increased, if elevated, the pain is decreased. Tissues or organs which are resistant and do not admit of much distention, as bone, testicle, palm of the hand, and the eye, are the site of very severe pain when inflamed. Some tissues and organs are more freely supplied with sensitive nerves than others and consequently more sensitive and the site of greater pain when inflamed.

It is probably true that the hyperemia and chemical changes going on in the tissues also heighten the sensitiveness of the nerves and increase the pain.

The character of the pain varies with the structure inflamed. In suppuration the pain is throbbing; in inflammation of a serous membrane it is often stabbing as in pleurisy; in bone it is boring or aching; and in a mucous membrane, burning. The pain of an orchitis is sickening, while that in a tooth is "jumping."

IMPAIRMENT OR LOSS OF FUNCTION.—Any tissue which is inflamed does not functionate normally. This may be due in part to the pain and exudate, the increase of heat, the disturbance of nutrition and the chemical processes going on in the tissues.

The muscles of the heart, when inflamed, lose their striations and become granular. The cells of the secretory glands undergo cloudy swelling and the connective and fibrous tissues are replaced by embryonal tissue.

It is then quite natural that an inflamed tissue which is in a state of degeneration or undergoing marked change, should not functionate normally.

In inflammation there are also certain systemic symptoms, such as fever, thirst, malaise, sleeplessness, loss of appetite, increased frequency of pulse, headache, mental disturbance, and a heightened color of the urine.

If the pathology and purpose of a local inflammation have been correctly stated, then the process is not necessarily to be combatted as harmful, but rather to be considered as beneficial and is to be encouraged, modified or controlled as the case may be, for the purpose of bringing it to a successful termination. Under ordinary conditions the hyperemia and inflammatory exudate are purposeful, while the proliferation of connective-tissue cells and the building of new capillaries are necessary for the repair of injured, or the replacement of destroyed, tissues. While the inflammatory exudate is usually beneficial, it may, if excessive, cause the patient great injury or lead to his death. An excessive inflammatory exudate within the interior of compact bone, or upon the membranes of or within the brain or spinal cord, may produce such pressure as to endanger the patient's life. An inflammatory exudate upon the epiglottis, or within the larynx, may cause suffocation.

The intent, then, of the treatment of such inflammations as fall naturally to the surgeon's lot should be to relieve pain; to prevent stasis in the circulation; to limit the exudate to the protective and reparative requirements of the tissue; and to render harmless, so far as possible, the cause.

The proper treatment of the inflammatory process will depend upon the tissue inflamed and the extent and cause of the inflammation. The treatment may be conveniently divided into local and constitutional.

THE LOCAL TREATMENT OF TRAUMATIC INFLAMMATIONS.—What is desired in the treatment is a sufficient amount of hyperemia and exudate to nourish, protect and repair the injury done. This is best secured, if the injury is to an extremity, by rest, elevation, and support. Rest not only removes the liability of renewed injury but relieves pain and irritation. Elevation is important as it favors the venous return circulation and thereby diminishes the possibility of stasis. Support, if properly applied, lessens pain, hyperemia, the amount of exudate and favors the venous return circulation. The support should be adapted to the needs of the part and may be secured by the application of a compress and bandage.

Rest, elevation, and support when applied to an injured extremity are often advantageously combined with immobilization of the adjacent joint or joints. In mild cases of trauma to the fore-arm, rest and elevation may be secured by placing the arm in a sling; if the injury is to the leg, by elevating it upon a chair or placing the patient in bed, and the limb upon a pillow. Rest, elevation, and support should be continued until pain, hyperemia and inflammatory exudate have been gotten under control, then passive exercise with massage are indicated. Massage and exercise increase the blood supply and promote the nutrition of the part, they also break up, diffuse, and favor the absorption of the exudate.

In acute inflammations with heat, hyperemia, inflammatory exudate, and swelling so excessive as to threaten the arrest of the circulation and

possibly gangrene, free incisions should be made for the purpose of relieving tension and maintaining the circulation. In cases with less intense reaction cold may be applied. Cold abstracts heat, produces contraction of the vessels, lessens hyperemia and diminishes the inflammatory exudate. It should not be applied to tissues whose vitality is much reduced or too continuously to any tissue. Dry heat is very serviceable in cases of severe injury with poor circulation, where it is necessary to conserve the vitality of the tissues. Moist heat may be applied to relieve pain. It is also of great benefit after the acute symptoms have subsided, for the purpose of stimulating the lymphatics and producing absorption of the plastic exudate. The continuous application of moist heat is seldom indicated during the first stages of an acute inflammation, and should never be applied to tissues in a low state of vitality.

THE LOCAL TREATMENT OF INFLAMMATION DUE TO OR COMPLICATED BY PYOGENIC INFECTION.—In these cases the purpose of the inflammatory reaction, the emigration of the leukocytes and the escape of the blood plasma is to encompass and destroy the micro-organisms. Rest, elevation, and support will assist in accomplishing these ends. In cases in which the micro-organisms are few in number or have a lessened virulence, the leukocytes and blood serum may succeed in destroying them. Ordinarily, however, the process is progressive and the surgeon must interfere actively in order to save the part and system from serious injury. It is now a well-recognized principle that in severe or progressive inflammations due to infection, free incision and perfect drainage are necessary if the part and patient are to be preserved from serious injury. The old idea that an incision should only be made for the purpose of giving vent to pus in a ripe abscess is entirely erroneous. With the formation of pus in any considerable amount there is great destruction of tissue. An early incision will preserve the vitality of tissues, shorten the course of the inflammation and diminish very materially the pain and suffering.

The incision should never be a punctured one, but should be sufficiently free so as to thoroughly expose the inflamed area, especially at its center, thus establishing perfect drainage. In some rapidly spreading infective inflammations a five per cent. solution of carbolic acid or permanganate of potash may be injected into the borders of the inflamed area for the purpose of limiting its progress. In some cases of uncontrollable phlegmonous inflammation, or rapidly spreading suppuration, or cellulitis of an extremity, the surgeon should resort to an early amputation, the limb being removed well above the upper portion of the inflamed area.

CONSTITUTIONAL TREATMENT.—In the treatment of a local inflammation one should not forget that the general condition of the patient may need careful consideration. Local inflammations are often complicated by, and greatly aggravated in consequence of, organic or systemic disease. Typhoid or other infectious fever, malaria, syphilis, disease of the heart, lungs, kidney, liver, or gastro-intestinal canal, if present, are sure to alter and greatly aggravate the course of any local inflammation.

In the progress of the case the treatment of the constitutional condition or of the diseased organ is often of more importance to the patient and to the local inflammation than is any treatment which may be directed

especially to the inflammatory process. If there is much rise in the temperature the patient should be kept quiet, preferably in bed. The room should be well ventilated and the light soft. A sponge bath in the morning, followed by an alcohol rub is always refreshing. The bowels should be kept open and the diet, while nourishing, should be liquid. Milk is perhaps the most suitable food for the majority of these patients. Meat broths may also be given, while coffee, tea, and cocoa should be used sparingly. One of the breakfast foods, a soft boiled egg, milk-toast with minced chicken may be given to patients who are somewhat advanced in convalescence. These patients usually crave fluids, and pure water for drinking is very beneficial. Orange-albumin makes a pleasant drink and is made with the juice of an orange, white of an egg and water, beaten together. In cases where there is much fever quinine may be administered in five grain doses, three times a day, for its tonic and antifebrile properties. In asthenic fever or decided weakness strychnin should be administered, either by the mouth or hypodermically, in from one-sixtieth to one-thirtieth of a grain. In these cases alcohol in some form is also beneficial. In injuries to the head followed by meningeal or cerebral hyperemia, the bowels should be freely opened, as this lessens blood pressure and relieves to some extent cerebral and meningeal irritation. These cases may also be benefited by bromide or iodide of potash. In cases of malaria or syphilis, the remedies suitable for these diseases should be administered.

ACUTE ABSCESSES.

For practical purposes it may be stated that all suppurative processes are due to pyogenic infection. It is true that a variety of chemical irritants such as croton oil, turpentine, and nitrate of silver are capable of producing a puruloid material; this fluid, however, is non-infectious, does not contain pyogenic micro-organisms, and has none of the properties of ordinary pus. It is also true that in non-febrile abscesses of long standing, as in some cases of pyosalpinx and tubercular abscesses, very few, perhaps none pyogenic organisms are to be found. In these cases there has been an arrest of the inflammatory process and death of the pyogenic organisms.

Sources of Infection.—There are usually two sources of pyogenic infection. One of these is external, the other internal. It has been repeatedly demonstrated that infection can occur through the glands of the skin. By this means pustules, boils and often carbuncles are produced. Garré was able to produce boils upon his own arm by rubbing into the skin cultures of staphylococcus pyogenes aureus. External infection is also of frequent occurrence through scratches, abrasions, and wounds. The internal infections occur usually through the blood and lymph channels. It is well known that the blood of persons who are in a debilitated condition frequently contains one or more of the pyogenic organisms. In these persons acute suppurative osteomyelitis may follow a slight injury to a bone, or suppuration may occur after a simple fracture, or suppuration may take place in a subcutaneous blood clot. Infected emboli are frequently carried through the circulation to small, terminal vessels where they become arrested. Each embolus becomes surrounded by an infected thrombus and these break down into abscesses.

In the abdomen suppurative processes are encountered in which the pyogenic organisms have passed through the walls of the appendices, either with or without necrosis, and produced adjacent abscesses. The same is true of abscesses in the vicinity of the gall bladder. In the female pelvis the pyogenic organisms follow the anatomical planes from the uterus or gain an entrance to the lymphatic or venous system of vessels and produce a pyosalpinx, a pelvic abscess, or a thrombo-phlebitis.

THE FORMATION OF ACUTE ABSCESSES.—When pyogenic organisms become implanted in a tissue under favorable conditions they multiply and produce toxins which are diffused into the surrounding tissues setting up an inflammatory action. The blood vessels dilate and the blood current becomes more rapid. This condition is followed by a slowing of the current or stasis with an escape of the blood plasma and leukocytes into the surrounding tissues. The toxins now act more vigorously upon the injured cells, destroying their vitality with the result that a central core of necrotic tissue is produced. This zone of necrosis contains many bacteria and is surrounded by a zone of inflammation in which there are a greater number of polynuclear leukocytes. The leukocytes are attracted to the inflamed area by the products of bacterial growth. As the process advances more leukocytes are attracted to the inflamed area, while the blood plasma continues to escape from the capillaries. The central necrotic core is finally separated from the living tissues by the peptonizing action of the products of bacterial growth and by the digestive action of the leukocytes. At this stage the central core is surrounded by a fluid, the liquor puris, which is the changed blood serum and which contains the pus cells, the former leukocytes. An abscess may now be said to have formed.

During the formation of an abscess changes are taking place in the surrounding inflamed tissues. The connective tissue cells proliferate and with the polynuclear leukocytes and new formed capillaries they build a wall of granulation tissue around the abscess cavity. This is a protective process brought about by the cellular elements for the purpose of limiting the spread of the abscess. When the toxins are very virulent or the vitality of the tissues reduced either the wall of granulation tissue will not be produced or will be imperfectly formed, or if formed it may be destroyed by the virulent toxins; in either event the abscess will continue to extend. Even with the formation of the protective wall of granulation tissue, the abscess ordinarily continues to increase in size and in the direction of the least resistance. The leukocytes and blood plasma are constantly escaping from the capillaries into the abscess cavity while the toxins are constantly destroying the inner layers of granulation tissue. In this manner the abscess constantly increases in size and finally points and bursts, discharging its contents. With the escape of the pus and toxins the cavity of the abscess rapidly diminishes in size. This diminution is caused by the formation of layers of granulation tissue internally, while the outer layers are converted into fibrous tissue, which contracts and diminishes the size of the abscess cavity. In some cases, with the formation of a wall of granulation tissue, the leukocytes and blood plasma are able to destroy the bacteria in the abscess and the growth ceases. In these the liquid portion of the abscess is absorbed, the leukocytes undergo degeneration, while the abscess cavity is obliterated by the formation of

granulation tissue within and the contraction of fibrous tissue without.

SYMPTOMS.—The local symptoms of a subcutaneous abscess are primarily those of an infection. There is redness, heat, pain, swelling, and disturbance of function. The parts at first are hard and brawny, but as the pus is formed and approaches the surface the center of the inflamed area becomes soft and fluctuant and later the abscess ruptures. If the drainage is good the symptoms gradually or suddenly subside. The rim of hard tissue which surrounded the soft, fluctuant center is gradually broken up and absorbed. After the abscess cavity is obliterated by the formation of granulation tissue and the contraction of the new connective tissue, all that remains is new connective, or scar tissue.

The subjective symptoms are pain, often throbbing in character, fever, and frequently a chill; there is usually insomnia, loss of appetite, and gastrointestinal disturbance.

DIAGNOSIS.—The diagnosis of an acute subcutaneous abscess is ordinarily easy. There will be an inflamed, tender area with a soft, fluctuant center, the latter being surrounded by a hard border. In abscesses which are situated deeper the soft area and sense of fluctuation will be absent, as in abscesses beneath the deep, cervical fascia; here the entire area may be hard and brawny or the surface may present an elastic resistance. If in doubt a hypodermic needle may be used or a blood count made for the purpose of determining the presence or absence of leukocytes.

After an abscess cavity has healed, the presence of soft granulation tissue may give to the examiner's fingers the sense of fluctuation. This error may be corrected by palpating the area in the opposite direction or in the direction of the muscle fibers.

TREATMENT.—Suppuration can sometimes be aborted by rest and by the application of ice or antiseptic lotions. Ordinarily, however, the process cannot be prevented and is to be favored by the application of moist heat. When the pus has formed, or even before this, a free incision should be made in the inflamed area for the purpose of giving vent to the pus and affording drainage or for the purpose of relieving tension. It is necessary in order to insure a speedy recovery that a free incision should be made and good drainage established. One or two rubber tubes suitable to the size of the abscess afford the best drainage for pus. If the abscess cavity does not readily diminish in size, and the flow of pus in a few days practically cease, it is probable that there are pockets of pus which are not being well drained. In this case the pus cavity should be explored with a sound or the finger, and these pockets cut down upon and drained.

In phlegmonous inflammation of the neck, where there is probable pus beneath the deep cervical fascia, and in other suppurative processes adjacent to important vessels, Hilton's method of opening an abscess should be practised. This consists in making a free incision through the skin and superficial fascia and over the center of the inflamed area and then locating the pus by thrusting a grooved director, or a pair of pointed but closed artery forceps, in the direction of the suspected pus. If pus is not encountered the forceps are withdrawn and then thrust into the tissues in a differe- direction. Having once located the pus, the blades of t within the cavity of the abscess are opened as wid

withdrawn while in this position, so as to tear a considerable opening into the wall of the abscess, and into the tissues, through which a drainage tube may be passed. The advantage of this method in certain inflamed areas over incision is that one is not likely by it to do injury to important structures. There is risk in making a deep incision into an inflamed area surrounded by important structures, because the lips of the wound cannot be retracted nor the anatomical structures of the part recognized.

In the opening and in the subsequent treatment of acute abscesses strict antiseptic precautions should be carried out, otherwise mixed infection may occur and the healing process be greatly delayed.

PUS AND ITS COMPOSITION.

Pus from an acute abscess is a yellowish fluid having a specific gravity of 1,030 and an alkaline reaction. If allowed to stand it separates into two parts; the pus serum, or liquor puris, derived from the plasma of the blood, and a sediment. The serum is of a pale-yellowish or greenish color and makes up from 80 to 90 per cent of the whole. It is an albuminous fluid and contains toxins, enzymes, and proteids. The sediment contains polynuclear leukocytes, bacteria, connective tissue shreds, granulation debris, and a few red blood-corpuscles. Pus from an acute subcutaneous abscess is practically odorless, while the pus from an abscess within the abdomen and adjacent to the intestinal canal usually has a very disagreeable odor. This is due to the presence of the bacillus pyogenes fœtidus, or to the bacillus proteus vulgaris. Pus may have a bluish color due to the presence of bacillus pyocyaneus. It may have an orange color in consequence of the presence of hematoidin crystals. Pus when mixed with blood is known as sanious pus; when thin and acrid, as ichorous pus; and when mixed with mucus as muco-pus. Occasionally an abscess is found to contain gas. This may be due to its connection with some hollow organ or to the presence of a gas-producing organism, such as the bacillus aërogenes capsulatus, or the bacillus edematis maligni.

ASEPTIC WOUND FEVER.

Not unfrequently after aseptic operations which are followed by primary union and are without visible signs of inflammation or infection, and after simple fractures or external injuries in which the skin is not broken and external infection not possible, the patient develops, during the first or second day, a fever of one or two degrees. This fever may continue from twenty-four to thirty-six hours and then disappear. This fever was termed by Volkmann "aseptic wound fever." It was thought to have its origin in the resorption of the fibrin ferment from the blood, but Schnitzler and Ewald hold that it is due to resorption of neuclein and albumose, which substances are always present in effused blood. It is known that many inert substances when injected into the blood are capable of producing fever, among these are normal salt solution, charcoal, and pepsin. It seems that [illegible] fever is more frequent after operations in which the loss of [illegible] hemostasis imperfect, and drainage omitted. The con- [illegible] ored by the use of antiseptics and by consider- [illegible] During the course of this fever there are no

[illegible] The patient does not feel ill, has no spe[illegible] [illegible] and sleeps well. The con[illegible] [illegible] traumatic fever. In [illegible] The patient feels ill and [illegible] twenty-four to thirty-six hours [illegible] until the wound is opened and drained or a [illegible]

[illegible] Hemorrhage should be [illegible] the wound drained.

SEPTIC TRAUMATIC OR SURGICAL FEVER OR SAPREMIA

[illegible] absorption of [illegible] growth, the [illegible] and operative wounds [illegible] and in [illegible] number of cases [illegible] bacterial [illegible] of granu- [illegible] ceases. [illegible] infected at the [illegible] assistants, from [illegible] cat-gut or from [illegible] of toxins and their [illegible] are removed and the [illegible] in consequence of [illegible] The bacteria which [illegible] factors of sapremia are the [illegible] and streptococci, although the [illegible] may also be present.

[illegible] three degrees F. usually [illegible] the infection. The [illegible] possibly a chill, and [illegible] is painful. If the toxins [illegible] diarrhea, exhaustion, [illegible] toxins which enter the [illegible] not only severe systemic [illegible] Ordinarily, however, toxemia runs [illegible] to treatment.

[illegible] sapremia is to be differentiated from aseptic wound fever and from septicemia. In aseptic fever the rise in temperature makes its appearance during the first twenty-four hours. There is but one or two degrees of fever, the patient is not ill and the subjective symptoms disappear in twenty-four or thirty-six hours. In septicemia the process is continuous and progressive and while drainage of the wound and the building of a wall of granulation tissue may have a favorable effect upon the course of the fever, they will not arrest it as in sapremia. Also in septicemia if the blood be examined the pyogenic organisms of the disease can usually be demonstrated.

TREATMENT.—The local treatment consists in asepticizing and draining the wound. By proper drainage the organisms are not allowed to remain in the wound, no more toxins are formed to enter the blood, and as there are no organisms in the blood, the process ceases. In severe cases antiseptic treatment will be advantageous. The injection of a pint or quart of normal salt solution into a vein or subcutaneously is often of great advantage in stimulating the secretions and excretions and thus washing out the blood. If the fever is considerable quinine may be administered. If the pulse is weak and rapid, and the patient exhausted, strychnine, caffine, or carbonate of ammonia may be administered. The diet should be fluid, nourishing and given at frequent intervals.

SEPTICEMIA.

This is an acute, general infectious disease due to the entrance and multiplication of one or more of the pyogenic organisms in the blood. The streptococcus is the etiological factor in about fifty per cent. of the cases. The pneumococcus and staphylococcus come next in frequency, although the disease may be caused by any of the pyogenic organisms.

THE MODE OF INFECTION.—In surgical practice infection usually occurs through some wound or abrasion of the skin. In obstetrics it is at the site of the detached placenta or through tears or abrasions of the cervix, vagina, and perineum. In gynecology infection occurs by traveling along anatomical planes, as the mucous membrane of the vagina and uterus to the Fallopian tubes, or through wounds or abrasions of the mucous membrane. In these cases either the lymphatics or veins may be primarily involved. The wounds of the skin and subcutaneous tissues are often punctured ones, as those received in making post-mortems, or those made by foreign substances such as slivers of wood, or by septic instruments, or infection may be the result of unclean operations, or follow severely lacerated wounds.

Three factors are generally present and essential to the production of septicemia. One is a debilitated condition of the system with lessened resistance, making the person especially susceptible to pyogenic infection. Another and absolutely essential condition is the presence in the wound of pyogenic micro-organisms, and those usually of extreme virulence. The third is absence of drainage, with tension in the wound. With the general debility and lessened resistance the action of the leukocytes and blood-serum is greatly reduced, making it possible, under the increased tension in the wound, for the micro-organisms to enter the blood through the lymphatics or where they readily multiply.

SYMPTOMS AND COURSE.—The process is ushered in with a fever which is usually continuous and often reaches 103 to 104 degrees Fahrenheit. There is frequently a chill. The wound is septic, painful, and the tissues swollen. There is insomnia and frequently nocturnal delirium. The gastro-intestinal canal is disturbed, with loss of appetite, and occasional vomiting and diarrhea. The patient loses flesh and strength rapidly. The skin assumes a yellowish tinge, the urine is scanty and high colored and the pulse quick. The weakness becomes extreme and the patient may die of exhaustion. Under favorable conditions and proper treatment, however, he usually recovers.

PATHOLOGY.—After death decomposition occurs early. The blood is dark and coagulates imperfectly. One or more of the pyogenic organisms can usually be found in the blood. The spleen is enlarged, the lungs congested and edematous, while the liver and kidneys are in a state of cloudy swelling.

DIAGNOSIS.—Septicemia is to be differentiated from aseptic wound fever, from sapremia and pyemia. Aseptic wound fever disappears of its own accord in twenty-four to thirty-six hours after its inception. In sapremia or toxemia the fever makes its appearance during the first or second day after the infection and continues until the wound is opened and thoroughly drained or until a wall of granulation tissue has formed, preventing absorption of the toxins, when the fever disappears as there are no pyogenic organisms within the blood. Septicemia is to be differentiated from pyemia by the occurrence of repeated chills and the formation of metastatic abscesses in the latter disease.

PROGNOSIS.—Ordinary cases under proper treatment usually recover. In severe cases the termination may be fatal.

TREATMENT.—Thoroughly asepticize and drain the wound of entrance. If the wound is a punctured one it should be freely incised, thoroughly irrigated and perfectly drained. If the wound is a lacerated one with its surfaces more or less covered with necrotic tissue, while the depths of the wound retain infectious exudate or pockets of pus, there should be thorough and repeated irrigations and the removal of all necrosed tissues with good drainage. No pocketing of exudate or pus is to be allowed in any portion of the wound. Following this moist, antiseptic dressings are to be applied and frequently changed. The proximal lymphatic glands, if much enlarged may be removed as they are foci of infection from which the pyogenic organism may enter the circulation. If abscesses form they should be freely opened and drained.

CONSTITUTIONAL TREATMENT.—Every effort should be made to destroy or eliminate the infectious agents. The antistreptococcic serum may be administered, if there is reason to believe that it is a streptococcic infection; although its use is empirical and its effect variable, it has seemed at times to afford the patient great relief. The subcutaneous or intravenous injection of normal salt solution is often beneficial as it aids in washing the organisms out of the blood by increasing the secretions and excretions. At times great benefit seems to accrue from the intravenous injection of a solution of formalin of the strength [illegible]. From one pint to one quart of this solution may be injected at a time.

Internal Medication.—Strychnine is usually beneficial in strengthening the heart and nervous system. Quinine may be administered for its effect upon the fever. Alcohol in some form is usually given in these cases, but its value has not as yet been fully determined.

The appetite should be encouraged and the patient prompted to take liquid and semi-solid food such as milk, beef tea, eggs, and the breakfast foods. The bowels, kidneys, and skin should be kept active.

PYEMIA

This is an acute or chronic general infectious disease due to the breakdown of an infected mass, thrombosis and the formation of many in-

fected emboli which gain an entrance to the arterial system and beco arrested in the terminal capillaries. The disease is characterized by an intermittent or remittent type of fever, frequent chills, great prostration, and the formation of metastatic abscesses in different parts of the body. Pyemia is caused by some one of the pyogenic organisms, usually the streptococcus, gaining an entrance to a vein where it causes the formation of an infected thrombus. The streptococcus causes the most virulent type of the disease, although the process may be due, and frequently is, to the staphylococc pyogenes aureus, the pneumococcus, the bacillus of typhoid, or any of t pyogenic organisms.

Pyogenic organisms which enter the lymphatic or venous circulati from an infected wound in a state of diffusion and find the conditions witl the circulatory system favorable for their growth and multiplication, pı duce septicemia. In order that pyemia occur these organisms must ent the circulation as agglutinated or zooglea masses or infected emboli.

The disease is most frequently brought about by suppuration in t vicinity of a vein or sinus. The suppurative process not being walled (by granulation tissue extends to and causes inflammation of the wall of t vein with the formation of a thrombus. The thrombus is infected and incapable of organization and breaks down into multiple infected embo These emboli are carried away by the venous return circulation to the rigl side of the heart, and from the heart they are sent to the lungs where son of them become arrested in the terminal capillaries, others pass throug the capillaries and return to the left side of the heart and are then sent o through the general arterial current. From here they become arrested the joints, subcutaneous tissue, spleen, kidneys, brain or bones.

With the arrest of an infected embolus within a capillary a thrombı forms about it and within the wall of the vessel, while the adjacent tissı also becomes infected. The process frequently results in the formation an abscess, from which, as a focus, additional infection occurs. The i fected emboli in passing with the blood through the heart may cause infective endocarditis; or being arrested in the lungs or other internal orgar in the joints, subcutaneous tissues, or bones cause multiple abscesses. in addition to the infected emboli there are non-agglutinated pyogenic o ganisms multiplying in the blood the process is known as pyosepticemia.

Clinical Course.—The characteristic symptoms of pyemia are a hig and irregular fever, frequent and severe rigors, great prostration, rapid lo of weight, yellowish color of the skin, and the formation of multiple meta tatic abscesses. The fever is intermittent or remittent in type. During chill it often reaches 103 to 105 degrees F., and in a few hours thereaft it may fall to normal, at which point it may remain for several hours, until the occurrence of another exacerbation. With each drop of the ter perature the patient feels relieved, while the friends, and even physicia gain courage; but this normal or slightly elevated temperature lasts but few hours when it takes a sudden rise, to be succeeded by a chill. Tl chills are irregular and may occur every day or every second, third or four but they do not recur regularly or at the same time of the day. Tl may have a marked rise of temperature without feeling chilly. Tl ually very severe and frequently last for a half-hour or mo

Following the chill there is usually a profuse perspiration. There are al occasional attacks of severe diarrhea.

Erythematous or petechial patches are frequently to be seen upon th skin and as the disease advances a pustular eruption often occurs. Th skin usually assumes a yellowish or icteric tinge; the breath has a peculia sweetish, hay-like odor, which is quite characteristic. The patient lose strength rapidly; the pulse becomes weak and rapid; the intellect, howeve is usually clear, although at times there may be some slight delirium. Dur ing the second or third week metastatic abscesses are likely to occur. Th knee, elbow, shoulder or metacarpo-phalangeal joints may become fille over night with pus. A joint so distended with pus is only moderately pain ful. Pus may appear beneath the periosteum or within the interior of a bone. The patient often complains severely when moved in bed in consequence of the presence of many painful areas in the subcutaneous or muscular tissues. These painful areas are due to the arrest within the tissues of infected emboli, which though producing local infection do not cause abscess formation. There is often a severe, dry cough with some consolidation of the lungs posteriorly. If an abscess or suppurating joint is incised there is little or no tendency to repair. The fever and chills continue, the emaciation and weakness become extreme, and the patient finally dies from exhaustion.

In less severe cases of acute pyemia and in chronic cases the symptoms are milder, the fever not so high, the chills less frequent, the prostration not so great, while pus formation may not occur and there may be but a single abscess. In these cases the symptoms may disappear and the patient finally recover.

POST-MORTEM APPEARANCES.—The primary wound is always in a septic condition. The veins leading from it are usually inflamed and thrombosed. The thrombi are infected and in a state of disintegration. Secondary abscesses are usually found in the lungs, subcutaneous tissue, joints and at times in the kidneys. The spleen is enlarged.

DIAGNOSIS. The diagnosis of pyemia will rest upon the foregoing symptoms, the principal of which are an infected wound, severe and intermittent fever, frequent chills, and the formation of metastatic abscesses.

PROGNOSIS. The acute and severe cases of pyemia practically always terminate fatally. In the less acute cases, and in chronic pyemia, recovery may take place.

TREATMENT. The prophylactic treatment is of great importance. Suppurative foci in the soft tissues, or in bone, if freely incised, completely drained and treated antiseptically are not likely to lead to pyemia. An infected focus in an accessible vein or sinus should be incised, washed out, and drained or the vein may be double ligated and excised. The protection of the veins in the immediate vicinity of a suppurating focus is the wall of granulation tissue surrounding the infected area. If this be destroyed by curettage or other means, it is quite possible for the infection to reach the unprotected veins and cause pyemia. Abscesses should be opened as they occur.

In the constitutional treatment advantage may be obtained by injecting into a vein a quart of normal salt solution, or a solution of formalin, 1 to

10,000. These injections may be repeated for a time every two or three days. The use of the antistreptococcic serum may be tried in cases of streptococcic infection. Ten c. c. of this serum are injected night and morning and then with an interval of one, two or three days, repeated. Internally, quinine, guaiacol, tincture of iron, and alcohol are frequently used. The food should be liquid and the patient encouraged to take as much as he possibly can assimilate. The bowels are kept open and any light attacks of diarrhea not interfered with. The patient must be kept scrupulously clean by frequent baths. The window in the sick room should always be kept partially or fully open for the admission of fresh air.

MALIGNANT EDEMA OR GANGRENOUS EMPHYSEMA.

This is a rapidly spreading malignant inflammation characterized by hemorrhage, edema, emphysema and gangrene.

There is some uncertainty as to the specific, causative factor of this disease. A large, straight bacillus was described by M. Pasteur under the

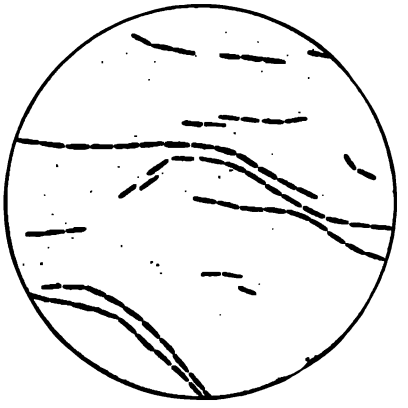

Fig. 103.—Bacillus of malignant edema.

name of vibrion-septique, and later by Koch as the bacillus of malignant edema. This organism when injected subcutaneously produces hemorrhage, edema, and gangrene; but there seems to be some doubt about its ability to produce gas. Many observers believe that in gangrenous emphysema the condition is either produced by the bacillus aërogenes capsulatus or that the two organisms are associated. These organisms are found in garden soil, they are anaërobic, and have a close family resemblance (Fig. 103).

Characteristics of the Inflammation.—Following infection by these micro-organisms there occurs a rapidly spreading inflammation. The part becomes greatly swollen, the skin is of a dusky red or mottled hue and usually covered with blebs containing a thin, bloody fluid. The part crackles when pressed upon owing to the formation of gas in the tissues. Patches of skin and cellular tissue become gangrenous. Primarily, if the part is cut into it will show a hemorrhagic edema, later there are shreds and patches of gangrenous tissue with a profuse, ichorous discharge. The general system is affected as the result of the absorption of the toxic sub-

stances. There is a high fever, occasional chills with great prostration ; often delirium, usually followed by death.

LOCAL TREATMENT.—If possible make a complete excision of the fected part or freely incise it and practice constant irrigation, or inject i the surrounding area a solution of carbolic acid in water, 1 to 20. If process is not controlled by these measures and it is an extremity, a h amputation should be done.

CONSTITUTIONAL TREATMENT.—The general system should be suppor by a liquid, readily assimilated diet and by strychnia, quinine, and possi alcohol.

CHAPTER VI.

CONTUSIONS, WOUNDS AND SHOCK.

A contusion is the result of a blunt force inflicted upon the surface of the body without breaking the skin. The extent of the contusion may be very variable, depending upon the force expended, the tissue injured and the conditions of the injury.

A severe injury to the head may produce contusion or laceration of the brain or its membranes. A contusion of the chest may cause rupture of the lung or laceration of the pleura, with subsequent traumatic pneumonia.

A contusion of the abdomen may cause instant death from shock or result in the rupture of some portion of the gastro-intestinal canal or of one of the solid viscera.

Contusions, however, as ordinarily considered in surgery, are those injuries of the skin and subcutaneous structures caused by some blunt instrument. The skin is not broken, and often in consequence of its toughness not severely injured. The injury to the subcutaneous tissue may consist of only a slight laceration of the connective tissue, with the rupture of a few small blood vessels and an injury to the sensory nerves, or the subcutaneous tissue may be separated from the skin for a considerable distance, while large vessels are torn, and muscles, even bone, pulpified.

The symptoms vary with the extent of the injury and the region injured. There is pain, increased by motion, tenderness, manifest on pressure, with swelling and discoloration. The pain may be so severe as to cause faintness (shock). The degree of swelling will depend upon the extent of the injury, the size of the vessels torn, and the looseness or compactness of the injured tissue. Such structures as the eye-lids, scrotum and vulva, in consequence of the looseness of these tissues, often swell enormously, while, on the other hand, the scalp and the tissues about the crest of the tibia, in consequence of their firmness, swell but little.

The discoloration of the skin (ecchymosis) is due to the extravasated blood which makes its appearance in the skin. This ecchymosis is much more pronounced in loose, cellular tissues than it is in more compact structures. Primarily, the discoloration is very dark, usually black; but in consequence of the disintegration of the blood, and its absorption, this color soon changes to a dark green, then to a yellow, and then gradually disappears. The blood may come directly to the surface or take a circuitous route around the muscular or fascial planes.

In deep injuries about the shoulder the ecchymosis may first be seen at the elbow. In injuries of the skin the discoloration often makes its appearance about the ankle. In injuries of the anterior half of the scalp, and in fractures through the anterior fossa of the skull, ecchymosis is primarily

seen in the eyelids or conjunctiva; while in fractures of the posterior fossa of the skull the discoloration will make its appearance anterior to the tips of the mastoid processes.

HEMATOMA.

While the actual amount of blood effused in contusions is usually small, in some cases a vessel of considerable size is torn and a hematoma, or blood tumor, is formed. This tumor for a short time following the injury is soft, fluctuant and without hard borders. In a day or two the major portion, and especially the circumference of the hematoma, becomes solid by the deposit of fibrin, while the center remains fluid. This condition when occurring beneath the scalp is often mistaken for a fracture, in that the central fluid area giving way before the finger, gives the impression of a fracture with depression, while the hard borders of the clot are thought to be the edges of the non-depressed bone. This error may be corrected by making firm pressure upon the clot, when it will yield and the finger will come down upon the bone; then by continuing the pressure, and carrying the finger across the central border of the clot to the fluid area, it can be demonstrated that the surface of the bone is smooth and without depression.

The condition may also have to be differentiated from an abscess. In a case of infection leading to pus formation there is, primarily, an induration followed by central softening with pus formation, the process being attended with heat and inflammation, the very opposite of the conditions following a hematoma.

THE COURSE OF A HEMATOMA.—A hematoma may gradually be absorbed and the part return to its normal condition, or the fibrinous deposit may become organized while the adjacent cells take on active proliferation producing a fibroid, fatty, or malignant tumor. The fibrin may be absorbed and a fibrous capsule formed containing serous fluid constituting a cyst. This condition not unfrequently follows blood extravasation in the arachnoid. Infection may occur and result in suppuration. The infection may take place through the circulation or through the skin.

PROGNOSIS.—The prognosis of a contusion will depend upon the extent of the injury, the tissue injured and the condition of the patient. Where all of the conditions are favorable the tissues return to their normal state in a week or ten days. If the tissues are so injured that they undergo degeneration or necrosis, then weeks may be necessary in order to restore the parts to their normal condition. Although regeneration of tissue may occur in these cases, ordinarily fibrous tissue is formed to take the place of the tissue destroyed. The rapidity and completeness of the repair will depend upon the condition of the patient and the extent of the injury. Persons in poor physical condition with diminished resistance, and those in whom suppuration has become established, will recover slowly and often imperfectly.

TREATMENT.—In the treatment of a contusion rest and elevation, with support and pressure by a bandage, are often all that is required. The bandage will, in a measure, control the hemorrhage and lessen the exudate. If the swelling is considerable and the circulation vigorous, cold or evaporating lotions may be used. Cold applied by means of a

hours is often very serviceable, but one must be careful not to reduce the vitality of the tissues too much. Cloths rung out of an evaporating lotion, such as chloride of ammonium, sixty grains, alcohol, two ounces, and a pint of water, are often used, or one may apply the lead and opium wash, a drachm of the acetate of lead with an ounce of tincture of opium in a pint of water. The application of a warm, carbolized solution is often very serviceable in that it hinders infection and relieves pain. Dry heat is especially to be recommended if the vitality of the tissues is low, in fact, neither cold nor wet applications should be applied to tissues having a low state of life.

When there is a large hematoma and one which is quite rapidly increasing in size, a free incision should be made for the purpose of turning out the clots and ligating the bleeding vessels. Also in cases in which, after a week or ten days, there is no tendency towards absorption of the clot, and its size is an annoyance and its presence one that is likely to invite infection, free incision with a turning out of the coagula and drainage is to be recommended. In some cases where the blood is still fluid aspiration may be practised. Under ordinary conditions, however, the clot is readily absorbed and incision contraindicated.

WOUNDS.

A wound is a solution of the continuity of any tissue produced by sudden external violence. This definition includes broken bones, ruptured muscles and tendons, and such subcutaneous injuries as are generally classified under the head of contusions. As ordinarily understood the term wound implies a solution of the continuity of tissue by sudden mechanical violence in which there is a break in the over-lying skin or mucous membrane.

CLASSIFICATION.—Wounds are primarily divided into two classes, *open* and *subcutaneous* wounds.

Open wounds are those in which the over-lying skin or mucous membrane is divided exposing the tissues to contact with the air. Open wounds are divided according to their characteristics into *incised, punctured, contused, lacerated, gun-shot* and *poisoned.*

Subcutaneous wounds are those in which the over-lying skin or mucous membrane is not broken and consequently the wound is protected from infection by external means.

Wounds are also divided into *penetrating* and *perforating*. The penetrating wound is one in which the instrument, or body causing the injury, has entered but not passed through some organ or portion of the body. The perforating wound is one in which the instrument, or body causing the wound, has passed through and emerged from some portion of the body or some organ.

Wounds are also classified as *aseptic* and *septic*.

An aseptic wound is one that is free from the micro-organisms of infection. It is probably true that no wound is absolutely aseptic, but what is meant here by an aseptic wound is that the micro-organisms which may be within the wound are not in sufficient numbers, or have not suffi-, to produce notable disturbance or to prevent healing by first

An aseptic wound may be such in consequence of the non-septic conditions under which the wound was received, or it may be aseptic in consequence of the efficient antiseptic measures which have been used.

A septic wound is one to which the pyogenic micro-organisms have gained entrance and produced a suppurative inflammation.

SYMPTOMS.—The symptoms of a wound are local, depending upon the effect produced upon the tissues injured, and constitutional, due to the impression upon the system at large.

The symptomatology of a wound may be summarized as follows:

(1) Pain. This is a very variable quantity, depending upon the extent and character of the injury, the tissue injured, and the condition of the patient. Ordinarily the pain from an incised wound is severe, sharp, and lancinating, while in contused and lacerated wounds the pain is rending or burning in character. The severity of the pain, however, depends very much upon the state of mind and temperament of the individual. A patient whose mind is very much preoccupied, or one who is greatly excited, may not appreciate any pain at all during the infliction of an injury. Again, persons of a lymphatic temperament often suffer but little, while those of a nervous or sanguine temperament suffer greatly.

(2) Hemorrhage is perhaps the most characteristic symptom of a wound, as it is always present. The amount of blood lost will depend upon the size and character of the wound, the tissues injured, and the condition of the patient. Incised wounds bleed freely, while contused and lacerated wounds bleed but little. Again some tissues are much more vascular than others, while certain conditions of the system such as hemophilia, scurvy, and anemia often lead to excessive hemorrhage even after insignificant wounds.

(3) Divided tissues always gape. This is due to the contraction and retraction of the divided tissues. The extent of gaping will depend upon the character of the tissues divided and upon the depth of the wound.

(4) Impairment of function is also one of the local symptoms of a wound. The extent of this impairment of function will depend largely upon the degree of the injury, as a divided muscle, tendon or bone does not functionate normally.

(5) Shock.

SHOCK.

Shock is one of the most pronounced, constitutional symptoms of a wound. Shock may be defined as a condition of general vital depression or a state of general exhaustion of the nervous system, coupled with dilatation of the peripheral arterioles and a loss of the normal blood pressure.

Shock may be the result of an accidental injury, an operation or a profound emotion. It is a condition in which the motor, sensory, and sympathetic nervous systems, as well as the cerebral cortex, are profoundly affected and their action, for the time being at least, more or less arrested or destroyed.

Shock follows very closely upon the action of its cause. W[illegible] result of an operation it may become manifest during any of [illegible] only at its close. Shock may make its appearance sudd[illegible] on gradually and be slowly progressive in charac[illegible]

SYMPTOMS.—The symptoms of shock will depend upon its severity. There may be as the result of some trivial injury a slight faintness, a pallor of the face, and a feeling of nausea which pass off in a moment; or the traumatism may be so severe and so sudden that the heart's action is arrested and the patient succumbs at once. In a well-developed case of shock the patient's sensibilities are lessened and his mental faculties held more or less in abeyance. The pulse will be quickened, feeble, thready, and perhaps irregular. The face and visible mucous membrane are pale, the eyes sunken and listless. The face, hands, and often the entire body, are bedewed with a cold, clammy perspiration. The tone of the muscular system is so lessened that it is capable of only feeble contractions, the sphincter muscles are at times completely relaxed. The temperature of the body may be reduced one, two, or even three degrees, or it may be elevated three or four degrees. The latter is probably due to infection. Nausea and vomiting occur in many cases. In the so-called erethistic form the patients are excitable, restless, and often incoherent and even delirious.

DIAGNOSIS.—Shock should be differentiated from fat-embolism, from hemorrhage and from the effects of ether or chloroform. With each or all of these it may, however, be associated. Fat-embolism most frequently occurs in injuries to the skeleton and makes its appearance as a rule about thirty-six to seventy-two hours after the injury, while shock occurs at once. In fat-embolism there is a restlessness, anxiety, dyspnea, accelerated respiration, quickened heart action, with fat globules upon the surface of the urine. Hemorrhage is very frequently an associated factor with shock and aggravates the latter condition, but the two may be, and often are, entirely separate.

Shock presupposes an injury. A patient may die from hemorrhage without suffering in any degree whatsoever from shock, while on the other hand a patient may receive a blow on the epigastrium, upon the head or have his limbs crushed off and suffer the loss of scarcely a drop of blood and still die almost instantly or within a few hours from shock.

Loss of blood, when external, is readily to be seen. When it occurs within closed cavities, as the abdomen, thorax, or skull, it will have to be diagnosed by the symptoms produced and by an examination of the hemoglobin.

The symptoms of hemorrhage are not always those which are most typical of shock, in that in the former there is more or less restlessness and nervous excitement, more acuteness of intellect, far greater pallor of the skin and visible mucous membranes, greater dilatation of the pupils and alæ nasi, and often a decided rise in temperature.

It will be impossible, at least as a rule, to separate the effects of chloroform and ether from those of shock. Either of these substances, when given incautiously or to excess, interferes with respiration, lowers blood pressure, and materially aggravates the condition of shock.

PROGNOSIS.—This will depend upon the degree of shock, upon the organ or organs injured, and also upon the presence or absence of sources of irritation which will maintain or aggravate the existing conditions. It may immediately fatal, if the traumatism has not vital organs, or exhausted the vaso-motor

nervous system, and the conditions are such that the shock is not constantly added to, the prognosis will be good. The injury may be to the brain, heart, or some other organ of vital importance and be of such a character, or produce such an exhaustion of the nervous system, that recovery is an impossibility.

Reaction from Shock.—With proper treatment, and under ordinary conditions, reaction will become manifest in a few hours. The cold perspiration disappears, slight color comes to the lips and cheeks, the eyes seem less sunken, and the face less pinched. The pulse gains in volume and loses something of its frequency, a flush comes to the cheeks, restlessness is increased, and reaction is fully established. If the injury has been such that the irritation is maintained for a time, reaction may be delayed or prevented, or the condition may oscillate between reaction with improvement and an aggravation of the condition of shock.

The Pathology of Shock.—The condition of vital depression known as shock seems inseparably connected with three pronounced conditions. One of these, and perhaps the most important, is the decrease of blood pressure; the second is the loss of muscular force; and the third a lessening of the mental phenomena, including the intellectual, emotional, and volitional.

For the proper circulation of the blood, a certain degree of blood pressure must be maintained. If this falls to a considerably lower degree, the capillary lake and venous system become flushed, the pulse is weak and thready, the arterial system depleted, the venous system congested, and the functions of the body disturbed or even arrested. The blood pressure is maintained in part by the vaso-motor system of nerves whose center is in the gray matter of the floor of the fourth ventricle. There are also certain subsidiary centers in the spinal cord. In health these nerves, acting upon the muscular tissue in the walls of the blood vessels and especially upon that in the arterioles, maintain an equable and constant tonic contraction, in consequence of which the heart is able to maintain the blood pressure throughout the general arterial system at a certain definite standard. A stimulus imparted to the vaso-motor system, either directly, through the splanchnic area, or indirectly through a sensory nerve, will increase the action of the vaso-motor system, the contraction of the peripheral arterioles and the blood pressure. If this stimulus is continued for an indefinite period, or is excessive in character, then the vaso-motor system becomes exhausted, the peripheral arterioles dilate, and the blood pressure is lowered.

There are three factors, however, which are responsible for the maintenance of a normal blood pressure. One of these is the forceful rhythmic action of the heart, another a suitable quantity of fluid in the vascular system, and a third a proper tonic contraction of the peripheral arterioles. If any one of these three conditions is disturbed the blood pressure will be affected.

By the kymograph and sphygomanometer it has been shown in cases of long continued operations and in cases of severe injury, that there is a lessening of blood pressure. This is due, in operations or injuries without the loss of blood, to the exhaustion of the vaso-motor system and a [illegible] of tone in the heart's muscular contractions. In cases in which

been hemorrhage it is also due to the diminution of the volume of fluid in the vascular system.

In every case of severe shock there is also a decided lessening or weakening of the mental phenomena. The intellect is inactive, the emotions are suppressed, and volition is at a standstill. There is also a muscular powerlessness. The patient is not only unable to exert his mind, but his muscles have also gone out of action. In severe shock there has been such an injury or stimulus to the nerves as practically to suspend the mental faculties, the functions of the motor and sensory nerves and the sympathetic system. It would seem that this condition is scarcely due in its entirety to the loss of blood pressure, but that the same crushing force which over-stimulated the vaso-motor centers and produced their practical paralysis, has over-stimulated the cortex of the brain, suspending in a large measure the action of the intellect, the force of the will, the play of emotions, and the function of the motor nerves.

It is often stated, following the teaching of Goltz, that patients dying of shock bleed to death in their own veins. This is supposed to occur in the splanchnic areas. The condition is simply one of vaso-motor paralysis in which the peripheral vessels have lost their tone and in consequence of which the blood rushes through the arterioles into the capillary lake and venous channels. While this condition perhaps occurs with greater force in the abdominal region than elsewhere, it does occur wherever there are arterioles and vaso-motor nerves which may be acted upon by over-stimulation.

PROPHYLAXIS.—In the prevention of shock one must place his patient, both physically and mentally, in the best possible condition. Just before the administration of the anesthetic, one-fortieth of a grain of strychnine, with one-eighth or one-quarter of a grain of morphine, may be given hypodermically with decided advantage, as both assist in supporting the heart's action and in maintaining the blood pressure, while the latter lessens to some degree the amount of anesthetic required and reduces the force of the harmful stimuli going to the brain.

For an anesthetic ether should be chosen in preference to chloroform, as the latter lessens very decidedly the blood pressure and favors the production of shock.

The heat of the body should be preserved, consequently the temperature of the room, at the time of the operation, and the covering of the patient, are matters of importance. The water used in the immediate preparation for the operation should be of such temperature as to abstract nothing of heat from the patient. Evaporating liquids, such as alcohol, must be used with care, and the towels about the field of operation, and the sponges, should be dry.

In the prevention of shock during an operation, or following an accident, it is of the greatest importance to limit the loss of blood to the least possible amount, as the blood pressure depends as much upon the amount of fluid within the vessels, as it does upon the contraction of the peripheral arterioles and the action of the heart. It is also essential, in order to limit amount of anesthetic to reduce the exposure of the patient,

that the operation be done as quickly as is compatible with the performance of good surgical work.

Cocainizing the main branches of the peripheral nerves before division has been recommended by Crile and Harvey Cushing for the purpose of blocking these nerves and preventing stimulating impulses being carried to the brain. The few experiments of this character which I have undertaken have seemed to show that the cocainization of a nerve causes about as much stimulation of the vaso-motor center as would its section. It is a fact, which may be easily established, that the handling, stretching, manipulating, or cocainization of a sensitive nerve will, in consequence of the irritation, at once raise the blood pressure. The same is also true of the section of such a nerve. Of course, this rise is followed by a subsequent fall: it is only a question as to which is the lesser evil. When a patient is under the influence of an anesthetic it would seem as though all of his sensitive nerves were, in a sense, blocked, and that not much more could be accomplished by their cocainization.

Treatment of Shock.—The treatment of shock may be considered under three heads:

(1) The recovery of the normal blood pressure.

(2) The re-establishment of the muscular tone, and

(3) The restoration of the mental phenomena.

The restoration of the blood pressure is at times more quickly effected by an intravenous infusion of a normal salt solution than by any other method, and in cases in which the condition is largely the result of hemorrhage this is the most scientific and satisfactory method of treatment.

Hypodermoclysis.—It is good practice when a pulse shows weakness, and especially if this be largely from loss of blood, to inject beneath a breast, at the border of the scapula, or in the lumbar or gluteal regions, a pint of normal salt solution, and to repeat this injection in half an hour upon the opposite side if necessary. The apparatus required is an aseptic fountain syringe attached to a large and surgically clean aspirating needle. While this method does not act as quickly as the intravenous infusion, it acts promptly enough for ordinary cases and is extremely simple.

In cases in which the blood pressure is lowered in consequence of exhaustion of the nervous system from gross injury, this treatment may still to a certain extent be advantageous, in that it produces some slight vascular stimulation and also adds to the volume of fluid circulating, and thus assists to a certain extent in compensating for the dilatation of the peripheral vessels. It is, however, a matter of frequent observation, in cases of profound shock with great weakness of the pulse, that the introduction into a vein of a quart of normal salt solution does not materially improve the patient's condition. The volume of the pulse in these cases may be restored for a few minutes, but this volume is without tension and soon disappears. This is in consequence of the fact that the vaso-motor system has become partially or completely exhausted. What is desired in these cases is the strengthening of the heart and the restoration of the functions of the vaso-motor system and of the cerebral cortex.

In my experience with shock there is nothing which meets this condition and stimulates the nervous system so well as strychnine. In the ad-

ministration of strychnine one-fourth of a grain may be given in divided doses during the course of one hour, and following this, one-thirtieth of a grain may be administered every two hours for one or two days, or until the muscles show the influence of the drug. Morphine should be administered for the purpose of obtaining rest and relieving pain.

In shock the patient's head should be lowered, and if there has been severe loss of blood the extremities may be bandaged.

Caffeine acts promptly and effectually in restoring blood pressure and may be given hypodermically in one-half to one grain doses.

In my experience adrenalin in one one-hundredth to one-fiftieth of a grain acts promptly in increasing blood pressure. This action seemingly, however, is not well sustained.

The immediate action of digitalis and strophanthus upon blood pressure is not pronounced. With a rapid pulse their use is indicated, as they will assist in controlling this factor and in maintaining blood pressure. Carbonate of ammonia in from two to five grain doses is also often very serviceable.

In the treatment of shock the conditions to be met besides that of blood pressure are the loss of muscular tone and the practical suspension of the mental faculties. These are more frequently corrected, in the absence of hemorrhage, by the use of strychnine, caffeine, morphine, adrenalin, and carbonate of ammonia than by any other remedies. In cases in which hemorrhage has been a prominent factor the normal salt solution should take precedence of all other remedies.

THE REPAIR OF WOUNDS.

The repair of wounds occurs by one of two processes, either cicatricial tissue is formed to fill the gap and bind the tissues together, or there is a regeneration of tissue such as occurs in fractured bone, divided nerves, and occasionally in glandular organs and in striated muscles. Wounds, ordinarily, however, heal by the formation of cicatricial tissue, and this healing is said to take place either by first, second or third intention.

The healing process is quite the same no matter what the cause of the defect, whether an injury, an inflammation, or an infection.

Healing by First Intention.—The healing by first intention of an incised wound which involves the skin and subcutaneous tissue, after the arrest of hemorrhage and the coaptation of the surfaces, may be described as follows:

The process of healing commences almost at once. The blood plasma coming from the divided vessels coagulates as a thin film upon the surfaces of the wound, binding them together. The vessels which have been divided become thrombosed and dilated. The leukocytes and blood plasma escaping through the walls of the capillaries and venules, fill the spaces in the wound and the meshes of the tissues adjacent thereto. Coincident with the escape of the leukocytes and blood plasma the connective tissue corpuscles in the immediate vicinity of the wound lose their prolongations and commence to proliferate. These cells are known as formative cells, or fibroblasts. This cell proliferation is carried on until upon each side of the wound, and ng in the center, there is a solid wall of round or irregular cells, which

is known as granulation tissue. The endothelial cells of the capillaries send out long, tapering, bulbous, protoplasmic processes which unite with like processes from other capillaries. These processes permeate the new granulation tissue in every direction. They become canalized through absorption of their central portion, and being in direct communication with the capillaries the circulation of the blood is established and the new granulation tissue nourished.

The next process is the conversion of the granulation tissue into fibrocicatricial tissue. It was formerly held that the fibroblasts in the granulation tissue became elongated or spindle-shaped and threw out long tapering extremities that were finally separated and formed the fibrous tissue. It is now thought that the formation of fibrous tissue is the result of a secretion by the fibroblast of a homogeneous inter-cellular substance, which later becomes fibrillated and converted into fibrous tissue. Coincident with this secretion by the fibroblast of the material which subsequently makes up the fibrous tissue, the leukocytes and many fibroblasts either enter the venules and lymphatics and disappear, or are broken up, disintegrated, and absorbed so that in place of the granulation tissues we have a fibrous tissue the fibres of which cross in every direction, binding the surfaces of the wound firmly together.

The functions of the leukocytes in the reparative process are the breaking up and carrying away of the blood clot and devitalized tissue, and the delivering of themselves up as food to the formative cells.

Upon the surface, beneath the aseptic dressings, the epithelium proliferates and covers the wound with epidermis. This proliferating epithelium comes from the stratum Malpighii and covers the tissues in several layers. It is seldom that papillæ are formed in scar tissue, although this occasionally occurs.

THE HEALING OF OPEN WOUNDS BY SECOND INTENTION.—This process of healing becomes necessary in wounds which the surgeon drains, in wounds which have become infected, and in wounds which, in consequence of the loss of tissue, cannot be approximated. Such a wound at the time of its infliction may expose the skin, subcutaneous tissue, fascia and muscle. During the first twenty-four hours its surfaces become glazed or covered over by the escape of blood plasma and lymph from the divided vessels, and then the various anatomical structures are hidden from view. This fibrinous film holds in its meshes innumerable leukocytes and the broken down debris from the surfaces of the wound. There is a constant discharge from the wound, which at first is red and serous and contains a quantity of red blood corpuscles. Later the discharge is of a dark yellowish color and then creamy or purulent if the wound is infected

Almost coincident with the covering of the wound by a fibrinous deposit and the escape of leukocytes and blood plasma, the connective tissue corpuscles commence to proliferate and form granulation tissue. The endothelial cells of the capillaries send out their prolongations and build new capillaries. The process here is identical with the one already described in the healing of a wound by first intention.

Upon the fourth, fifth or sixth day, depending upon the vigor of the circulation and the health of the individual, the fibrinous film which has

covered the wound is washed away by the discharge, exposing the surface covered with bright red granulations. The individual granulations stand out prominently, often they are the size of a pin's head, are elevated, and usually bright-red in color. The gap now existing and known as the wound is obliterated, and the wound closed by the coincident action of several processes. One of these is the growth of granulation tissue which tends to fill in and obliterate the cavity or defect. Another and very important process is the conversion of the deeper layers of granulation tissue into fibrous tissue, which contracts and tends to obliterate the cavity and bring the surfaces together. One notes the absence of this process and its ill effects on healing in indurated wounds and chronic ulcers, where the base and borders are adherent to adjacent tissues, and in consequence of which the contraction of tissue and the obliteration of the cavity is most difficult. As the cavity of the wound is obliterated the surfaces become covered over by the growth of epithelium from its borders.

HEALING BY THIRD INTENTION.—A wound which has been kept open for any purpose and in which the surfaces can be approximated, provided that its granulating surfaces are rendered aseptic, freshened and well brought together, will heal as by first intention.

THE CHARACTERISTICS AND TREATMENT OF WOUNDS.

INCISED WOUNDS.—An incised wound is one made with a clean cutting instrument. It bleeds freely and has a sharp edge and a smooth surface upon which there is but the faintest amount of injured or dead tissue.

Treatment.—The treatment of an incised wound will depend largely upon the presence or absence of infection. In the treatment of any wound the first consideration is the arrest of hemorrhage. Vessels of any considerable size, and especially those that spurt, should be ligated. This is best done with catgut, and the smallest strand that is capable of holding the walls of the vessel in contact until a firm thrombus has formed is most suitable. In clean wounds the surfaces are then united, tissue to tissue. This is ordinarily best done with catgut, while the skin is approximated either by interrupted silkwormgut sutures or by subcuticular suture of silkwormgut or horse hair. Where great firmness is essential it is often desirable to pass sutures of silkwormgut so as to include all the layers of the wound, or, as in cases of laparotomy wounds, all of the layers down to the peritoneum, which has been previously closed with fine catgut, and then unite subsequently the fascia in layers with chromicized catgut.

Incised wounds which are possibly septic should be asepticized and drained. This may be accomplished, perhaps, by irrigating with a one per cent. carbolic or 1:10,000 bichloride solution, and rubbing the wound vigorously with a sterilized brush or cloth during the irrigation. If the wound is handled or rubbed very much the amount of subsequent oozing will be great and will require free drainage. After thorough cleansing the wound may be lightly sutured.

Ordinarily in a septic wound the fewer sutures introduced the better, and these should be either absorbed or so placed that they can be removed.

In casualty wounds, after the arrest of hemorrhage, attention should be given to the condition of shock and the relief of pain. The wound should then be asepticized, sutured, if thought best, drained and dressed.

PUNCTURED WOUNDS.—A punctured wound is one made with a pointed instrument. The instrument may be sharp, making a clean cut, or it may be dull or obtuse, producing a contused and lacerated wound. If the wound is made with a dull or blunt instrument the amount of devitalized tissue along its borders is very much increased. Some of these wounds are made with sharp, pointed knives, as the ordinary stab wound, while others are made by nails or slivers of wood. In some cases foreign bodies, such as pieces of wood or broken needles, are left hidden within the tissues. These wounds ordinarily do not bleed very freely unless some important vessel has been injured.

Punctured wounds made by clean, sharp, aseptic instruments, heal kindly provided no serious damage has been done to important vessels. They ordinarily require very little treatment.

As these are usually emergency wounds before application of the first dressing the skin should be thoroughly scrubbed with a brush, soap and water, then carefully wiped off with a clean sterilized towel and washed with alcohol, followed by bichloride of mercury. Some slight provision may be necessary for drainage, if so, the placing within the wound of one or two strands of sterilized catgut is usually sufficient. Sutures are usually unnecessary and the dressing is completed by the application of a compress and bandage. The principles of treatment of infected, punctured wounds such as those made by nails and slivers of wood, are to thoroughly asepticize the wound and then to establish free drainage. The wound should be enlarged by a free incision so as to completely expose its depths. It should then be thoroughly scrubbed and irrigated and any foreign particles present removed. These infected wounds are dangerous if left alone, or if treated expectantly by the application of a compress and bandage, in that drainage is practically impossible and the infection, not being able to reach the surface, readily extends along the anatomical planes into the adjacent tissues. With free incision foreign matter may be removed, the wound cleansed and readily drained.

THE REMOVAL OF SMALL FOREIGN BODIES IN WOUNDS.—It frequently happens in punctured wounds made with slivers of wood, or needles, that a portion of the foreign body becomes broken off and lodges in the depths of the wound, where it is difficult to locate and extract it. Small foreign bodies may, however, be extracted readily by turning down a horse-shoe shaped flap of the skin and subcutaneous tissue. This flap should have the wound in its center and its base should be situated in the direction the foreign body has taken, on turning down the flap, the foreign body is usually found clinging to the meshes of the fascia or fat and can be readily extracted.

CONTUSED AND LACERATED WOUNDS.—A contused wound is one in which the injury has been done by a blunt instrument, causing the bruising or crushing of the tissues.

A lacerated wound is one in which the tissues have been forcibly rent or torn asunder.

These wounds have so much in common that they may be considered under one heading. There is ordinarily but little bleeding from such a wound. This is in consequence of the crushing and tearing force which has caused the injury. In this rending of the tissues the internal and middle

coats of the vessels give way, while the outer fibrous coat is drawn out like a strand, occluding the vessel. The arrest of hemorrhage is also very much favored by the shredding of the tissues, which favors coagulation of the blood.

In these wounds there is always a large amount of devitalized tissue. This may hang in great shreds and often includes strands of skin, fascia, muscle and tendon. These wounds are practically always septic, in that the grease from machinery, the dirt from the skin, or portions of dirty clothing or other foreign matter is often ground into the wound.

In the treatment hemorrhage, which is usually slight, must be arrested. Every vessel which bleeds should be ligated, and many vessels which do not bleed in consequence of the shock and lowered blood pressure, will be the site, perhaps, of hemorrhage when reaction is established and blood pressure restored.

The condition of shock and the severity of pain may now require the surgeon's attention.

The next consideration is the removal of necrotic tissue and the cleansing of the wound. Any long, dangling shreds of tissue, which are useless or likely to be devitalized, should be removed. This will lessen the amount of tissue to be disintegrated and gotten rid of by suppurative and putrefactive processes. The greatest possible effort should be made to asepticize the wound at the first dressing.

Experience has shown that if foreign or other material containing pyogenic micro-organisms is allowed to remain in a wound for more than a few hours satisfactory cleansing is then impossible and the wound goes on to profuse suppuration.

In the attempt to asepticize an infected wound one should be prodigal of his time. It is often advisable to anesthetize the patient, especially if the wound is large or there is much nervousness or undue sensitiveness. Every recess must be thoroughly scrubbed with soap and water and well irrigated. It should then be sponged off with alcohol, and later washed with a carbolized or bichloride solution. In these cases in consequence of the bruising, the amount of necrotic tissue, the liability to remaining infection and the profuse serous exudate, it is best to make free provision for drainage by drainage tubes or light gauze packing. The wound surfaces are approximated by compress and bandage.

Some contused and lacerated wounds, in which the amount of devitalized tissue is not great and can possibly be removed by the leukocytes and giant cells of the part, after thorough cleansing may be loosely approximated by suture, with the expectation that they will heal by first intention. In all of these cases a large dressing should be applied because the discharge will be profuse. The dressings should be changed under antiseptic precautions at least once a day, and at each change the surface of the wound thoroughly cleansed by irrigation or by the use of alcohol.

GUNSHOT WOUNDS.

These have been defined as injuries inflicted by missiles, whose force arived from the explosion of gunpowder. The gunshot wounds met with actice, in which the weapon is a revolver, differ materially from

those produced by the modern rifle and encountered especially in war. The cartridge of a revolver is usually loaded with black powder and has a soft lead bullet. The initial velocity of such a bullet is not more than one or two hundred yards per second, and consequently it has, as compared with the modern rifle or automatic repeating pistol, a greatly reduced penetrating power.

Lessened velocity favors the introduction of septic material, in that the bullet is more likely to be septic and to carry into the depths of the wound infection from the skin and clothing.

In consequence of the bullet being soft and easily expanded or distorted it makes a much larger wound than would otherwise be produced, and the edges of the wound are covered with devitalized tissue. When a soft leaden bullet strikes a bone with any considerable energy it flattens out upon its surface, smashes the bone into innumerable pieces, or bores a great hole into or through it.

The injury done by a large leaden bullet having considerable velocity is ordinarily much greater than that done by a bullet from a modern rifle, unless the latter is at a close range.

The *prognosis* of these wounds will depend upon the region and tissue injured, the extent of the injury, the presence or absence of hemorrhage or infection, and the size and striking energy of a bullet.

Wounds on the scalp are not likely to be dangerous unless a severe degree of infection occurs. Compound fractures of the vault of the skull, without injury to the dura and without infection, are readily recovered from. All wounds in which the dura and brain are penetrated are extremely dangerous. This danger lies in the extent of the injury and in the degree of hemorrhage and infection. The penetrating or perforating wounds of the brain, which do not implicate the base and are not followed by infection or severe hemorrhage, are often readily recovered from. In fact the danger to life here is almost entirely due to laceration of the brain, to hemorrhage, and infection. If the injury to the brain and the extent of hemorrhage are not severe, and infection can be prevented or controlled, the patients usually recover.

In the *treatment* of a compound fracture of the vault the head should be shaved, the scalp thoroughly scrubbed and cleansed, the wound asepticized, splinters of bone and foreign material removed, depressed bone elevated, and the wound drained. If hemorrhage is severe and comes from a vessel in the scalp or dura, the wound may be enlarged for the purpose of securing the bleeding vessel. A pair of artery forceps may be left on a bleeding vessel until it becomes thrombosed. If there is severe hemorrhage from the brain an effort should be made to control this by pressure with [illegible] or by carefully packing a wick of iodoform gauze within the wound.

[illegible] the bullet lies upon the bone or beneath the dura and is readily ac-[illegible] should be removed, but no extended search should be made for [illegible] when lodged within the brain, as experience has shown that [illegible] done by extended manipulations than the bullet will [illegible]

[illegible] the bullet should be drained by inserting within it strands [illegible] infected a fatal termination is probable, but an

effort should be made to asepticize and freely drain the tract. If an abscess forms about the bullet the latter may be located by the X-ray, when, if practicable, it is cut down upon and removed and the abscess drained. The constitutional treatment is largely symptomatic. The head should be elevated, ice applied and the patient kept quiet.

The principles of treatment in gunshot wounds of the base of the skull do not differ from those of the skull. Cavities, if entered, should be asepticized, foreign material removed, the cavity drained and then lightly packed with iodoform gauze. Gunshot wounds of the base of the brain are, however, usually fatal.

In gunshot injuries of the *chest wall* the local treatment consists in the control of hemorrhage, the removal of any detached pieces of rib, and the cleansing and drainage of the wound. If an intercostal artery has been divided and the pleura opened the hemorrhage may be external, but more often it will be into the pleural cavity with dullness over the corresponding lung and evidence of internal hemorrhage.

The treatment here is to resect a rib or ribs, corresponding to the site of the injured vessel, and to secure and doubly ligate the vessel. The blood in the pleura should then be turned out and the pleura drained.

In gunshot wounds implicating the lung itself the special indications for treatment are the control of hemorrhage and the relief of shock. The control of hemorrhage is a hazardous procedure, requiring the resection of many ribs, an opening in the pleura of sufficient size to admit the hand, the turning out of clots, the seizure of bleeding vessels with forceps or the packing of the pleural cavity with large strips of iodoform gauze.

The operative treatment of bullet wounds of the heart, attended with hemorrhage into the pericardium, consists in the turning down of a large flap of skin and the resection of several ribs. The pericardium should then be opened and the blood clots turned out, when the wound in the heart may be closed by interrupted sutures of silk and the pericardium drained.

In bullet wounds of the abdominal wall, the same principles of treatment apply as in other gunshot wounds. The bullet, if accessible, should be extracted and the wound drained. In civil practice, and with good hospital facilities, bullet wounds which have penetrated the abdomen should be treated by laparotomy with control of hemorrhage and the repair of any injury done to abdominal organs.

Penetrating wounds made with small calibre bullets, such as number 22, without symptoms of hemorrhage or severe shock, and in the absence of the above named facilities, may well be treated expectantly.

When perforation of intestines or stomach has occurred, with extravasation, after closing the perforations the abdominal cavity should be flushed with a warm saline or mild antiseptic solution and drained, large tubes being carried down to Douglas' cul-de-sac and the patient, when put to bed, placed in a sitting posture.

In bullet wounds of the extremities, without injury to the bone, the treatment is often simple and largely expectant. If hemorrhage is present it should be controlled by ligating the bleeding vessel, then the surrounding area should be cleansed and the bullet extracted, if accessible. No probing should be done for bullets in any situation, except under the strict-

est aseptic precautions, and neither at the first or any subsequent dressings should any long and tedious search be made for the bullet. Subsequently, if it is causing irritation, or the tract becomes infected, the bullet may be located by a radiograph and extracted.

WOUNDS MADE BY FOWLING PIECES—SHOTGUNS.—These are contused and lacerated wounds, and their severity will depend upon the amount and kind of powder used and the distance and size of the shot. Shot is of very variable size, the smallest bird shot being but the fraction of a pin head and weighing but one-fifth of a grain, while buck shot has a diameter ranging from 28-100 to 38-100 of an inch.

At short range a modern shotgun, with a shell loaded with smokeless powder and carrying even not larger than No. 4 or No. 6 bird shot, will do frightful execution. Such a shell at a distance of from twenty to forty

Fig. 104.—Wound of the hand made by fowling piece. A—wound of entrance; B—wound of exit.

feet will cut a hole, an inch and a half to two inches in diameter, through a pine board an inch and a half in thickness. The execution will decrease with the distance in consequence of the scattering of the shot and their lessened energy (Fig. 104).

The principles of treatment here are the same as those applicable to other contused and lacerated wounds. They are primarily to arrest hemorrhage and relieve pain and shock, and then carefully to asepticize the wound and surrounding area. Following or coincident with this any accessible foreign or loose bodies, such as shot pellets, pieces of clothing or detached portions of bone, should be removed and the wound drained.

WOUNDS MADE WITH THE MODERN SMALL CALIBRE RIFLE.—It has been the purpose of military men and manufacturers during the last century to so construct a rifle that it would give a bullet great velocity, a flat

trajectory, and great penetration, the bullet still being of light weight. During the past one hundred and fifty years great changes have taken place in the mechanism of the rifle, the kind of powder used, and the hardness, size, and weight of the bullet.

Until 1851 the smooth-bore, muzzle-loading rifle was used. The bullet was conical, measured from 17.6 to 19.2 millimeters, and weighed from 37.6 to 31.4 gm. From eighteen to twenty grams of loose black powder were used. The Minie rifle was introduced in 1851, the bullet was conical and the powder was black. Its effective range was from 600 to 1,000 yards. The Enfield rifle was introduced in 1885. The bullet was cylindro-conical, of 14.5 millimeters and of soft lead. The powder was black and the effective range was from 900 to 1,200 yards.

Fig. 105.—Shell of the Spanish Mauser rifle—actual size.

Fig. 106.—Shell of the Krag-Jorgensen rifle.

Fig. 107.—Shell of the Lee-Metford rifle—actual size.

The needle, breech loading rifle was introduced in 1864. Black powder was used, the bullet was oval and of soft lead, and the effective range was from 1,000 to 1,800 yards.

The Lebel rifle was introduced in 1886. The bullet was cylindro-conical, of 8.19 mm. calibre. It was composed of hard lead with a cupro-nickle case and weighed 15.1 gm., 2.8 grams of smokeless powder was used. The initial velocity was 600 yards per second with an effective range of from 3,000 to 4,000 yards.

In the Spanish-American war the Spaniards used the Mauser rifle. The powder was smokeless, the ball was 7 mm. in diameter, had a lead core and a hard casing consisting of eighty per cent. copper, twenty per cent. nickle, and a fractional part of steel. The Mauser has a muzzle velocity of 2,300 yards per second (Fig. 105).

The Americans used the Krag-Jörgenson rifle, with smokeless powder. The bullet is a little larger than the Mauser (7.8 mm.) and has the same hard coating. The initial velocity and range are slightly less than the Mauser (Fig. 106).

In the South-African war the Boers used the Manlicher rifle with hard cased bullets, 8 mm. in diameter, and smokeless powder. The British used the Lee-Metford rifle with hard bullets, 7.89 mm. in diameter, and smokeless powder. The rifle has a muzzle velocity of 2,000 feet per second (Fig. 107).

In the Russian-Japanese war the Japanese used the Mauser rifle, smokeless powder and a hard cased bullet having a diameter of about 7 mm. The Russians used a modified Mauser rifle, hard cased bullet of 7.65 mm. diameter, and smokeless powder.

Comparative Measures of Smokeless and Black Powders.—Twenty-five grains of DuPont, 16 grains of L. & R. Infallible, 24 grains of Schultze, 16 grains of Ballistide, equal 2 drachms of black powder.

Smokeless powders are divided into two classes, low and high pressure powder. The low pressure powder gives but little increased velocity over the black powder and they are loaded bulk for bulk. High pressure smokeless powders give a breech pressure of from 30,000 to 50,000 pounds to the square inch, and an initial velocity of from 2,000 to 2,500 feet per second.

The Effect of High Pressure Powder Upon a Bullet.—The great velocity of a bullet from a modern rifle gives it a comparatively flat trajectory. It is said that a modern rifle may be fired point blank at 500 yards, but this is arranged for by elevating the muzzle of the rifle, as no bullet has a perfectly flat trajectory. The force of gravity and the resistance of the air tend to curve the bullet downward, so that the bullet from the flattest cartridge, when sighted at 200 yards, will at 100 yards have risen three inches and at 200 yards will have fallen about seven inches. The bullet from the flattest cartridge will fall sixteen feet during the first second.

The heavier the charge of powder and the lighter the bullet, the greater the velocity and the lower the trajectory. The lead of the modern bullet is hardened by adding one part in sixteen of tin. This is to insure its taking the grooves in the rifle and not stripping. The casing of the bullet, consisting of copper, nickle and steel, is for the purpose of preventing it from flattening out or expanding when striking hard objects. The bullet in consequence of its great velocity and hardness will make a clean hole through almost any object with which it comes in contact. When at short range, however, that is from 500 to 750 yards, it develops at times an explosive action.

The Effect of Modern Bullets and High Pressure Powders Upon Wounds.—The explosive action of bullets occurs at short range and depends upon the velocity, striking energy, size of the bullet and the resistance of the tissues. Short range for the modern rifle is considered to be any distance up to 1,000 yards. Within this distance the bullet has such a tremendous velocity, and develops such an enormous energy, that it transmits a lateral force to certain tissues through which it passes. This explosive force is especially marked in organs which contain large quantities of fluid such as the brain and hollow viscera. The process is also noted in the end of long bones. It is presumably due to some of the bullet's energy being transmitted laterally to the particles in immediate contact, and from those to other particles until an explosive wave is produced. A bullet fired through the head at short range may not only disrupt the bones, but completely

Fig. 108.—A piece of shell extracted from behind the fibula which had entered in front and cut the anterior tibial vessels. A—actual size.

In the South-African war the Boers used the Ma[illegible] hard cased bullets [illegible] mm. in diameter and smokeless pow[illegible] used the Lee-Metford rifle with hard bullets, 7.85 mm. [illegible] smokeless powder. The rifle has a muzzle velocity of 2.00[illegible] (Fig. [illegible])

In the Russian-Japanese war the Japanese used the Ma[illegible] less powder and a hard cased bullet having a diameter of a[illegible] Russians used a modified Mauser rifle, hard cased bullet o[illegible] [illegible] and smokeless powder.

Comparative Measures of Smokeless and Black Po[illegible] five grains of Du Pont [illegible] grains of L. & R. Infallible, 24 g[illegible] 16 grains of Ballistide equal 2 drachms of black powder.

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The Effect of High Pressure Powder Upon a Bullet.—[illegible] ity of a bullet from a modern rifle gives it a comparativ[illegible] It is said that a modern rifle may be fired point blank at [illegible] is arranged for by elevating the muzzle of the rifle, as n[illegible] fectly flat trajectory. The force of gravity and the r[illegible] tend to curve the bullet downward, so that the bulle[illegible] cartridge, when sighted at 200 yards, will at 100 yards ha[illegible] and at 200 yards will have fallen about seven inches. [illegible] flattest cartridge will fall sixteen feet during the first s[illegible]

The heavier the charge of powder and the lighter t[illegible] the velocity and the lower the trajectory. The lead [illegible] is hardened by adding one part in sixteen of tin. [illegible] taking the grooves in the rifle and not stripping. The [illegible] consisting of copper, nickle and steel, is for the pur[illegible] from flattening out or expanding when striking hard o[illegible] consequence of its great velocity and hardness will mak[illegible] almost any object with which it comes in contact. [illegible] however, that is from 500 to 750 yards, it develops [illegible] action.

The Effect of Modern Bullets and High Pre[illegible] Wounds.—The explosive action of bullets occurs at sh[illegible] upon the velocity, striking energy, size of the bulle[illegible] the tissues. Short range for the modern rifle is co[illegible] tance up to 1,000 yards. Within this distance the bu[illegible] dous velocity and develops such an enormous ener[illegible] lateral force to certain tissues through which it passe[illegible] is especially marked in organs which contain large [illegible] as the brain and hollow viscera. The process is a[illegible] long bone. It is presumably due to some of the bull[illegible] mitted laterally to the particles in immediate cont[illegible] other particles until an explosive wave is produced [illegible] the head at short range may not only disrupt th[illegible]

SYMPTOMS AND LOCAL TREATMENT.—The symptoms and treatment will vary with the grade of infection. When the patient is not especially susceptible, nor the infectious material very virulent, the symptoms will be represented by slight redness, swelling and pain. These symptoms usually disappear in a few days under proper antiseptic treatment. The systemic disturbances are either slight or absent. In cases of severe infection there is likely to be a rapidly spreading cellulitis, with marked redness, great swelling, severe pain, and necrosis of tissue or pus formation. If the process invades the lymphatics there will be red streaks extending up the limb. The systemic disturbance will be represented by high fever, perhaps chills, severe pain, great weakness, rapid pulse, loss of appetite, and perhaps, delirium. The proximal lymphatic glands will be enlarged, and unless relief is obtained the patient is likely to die from septicemia or pyemia.

In the local treatment of mild infection bleeding should be encouraged, as this washes out the poison. The wound should be asepticized and, if thought best, a hot fomentation applied for the purpose of favoring the discharge.

In cases in which a severe infection is feared bleeding should not only be favored, but a fillet may be thrown about the finger for the purpose of preventing absorption and the wound freely incised, washed out and cauterized; after this hot, antiseptic fomentations should be applied. If the symptoms show that there is a rapidly spreading infection of the skin and subcutaneous tissues, these structures should be freely incised, thoroughly irrigated and drained. In some cases constant irrigation with some mild antiseptic will be indicated, in others, the limb may be packed in ice for the purpose of arresting or hindering the spread of the inflammation. The use of anti-streptococcic serum is also to be recommended in rapidly spreading infectious inflammation. If the inflammation cannot be gotten under control by these measures, and shows a high degree of virulence, the limb should be amputated well above the seat of the inflammation.

Constitutional treatment should be directed toward the support of the system. Quinine may be given advantageously as a tonic, and for its effect upon the fever. Strychnia is serviceable and alcohol often beneficial, while a light, easily digested but plentiful diet is indicated. The patient may require more or less morphine for the relief of the pain.

INSECT BITES.

The bites and stings of insects such as bees, mosquitoes, spiders, hornets, yellow jackets, and tarantulas are insignificant or severe, depending upon the susceptibility of the individual, the number of traumatisms inflicted, and the amount of poison introduced. A single bite or a few stings of a small insect are ordinarily of little consequence, because neither the pain, swelling nor constitutional symptoms are severe. Bites and stings occurring in loose, cellular tissue, as the eyelids, may cause severe swelling, and if the poison from a single bite is thrown directly into the circulation it may cause serious constitutional disturbance.

Children and susceptible persons if attacked, for instance, by a swarm of bees will suffer severely. The exposed parts become greatly swollen, the constitutional disturbance is severe, while the shock may be so great as to cause death. The bites of centipedes are usually attended with only

local disturbances. The bites of large spiders may be followed by swelling, weakness and even death. The bite of the tarantula and the sting of the scorpion may produce profound disturbances, such as vomiting, vertigo, headache, insomnia, prostration, and delirium. Locally, there is swelling, pain and possibly gangrene. The poisonous secretions of bees and insects contain formic acid and indican.

In the *treatment* of the stings of bees, the sting, if broken off, should be extracted with a sharp-pointed bistoury, and then a solution of aqua ammonia or bicarbonate of soda applied, or a salve containing ichthyol.

In the bites of large spiders and the more venomous insects bleeding should be encouraged and if necessary the wound incised and hot, carbolized compresses applied. A five per cent. solution of permanganate of potash may be injected into the surrounding subcutaneous tissues. If there is much prostration the general system should be supported.

SNAKE BITES.

The venomous snakes of America are the copper-heads, rattlesnakes, moccasins, and vipers. There is also a venomous lizard. In all reptiles the poisonous fluid is secreted by a gland placed at the side of the skull just below and behind the eye. From this gland a duct leads to a hollow tooth or fang in the upper jaw. Except in vipers the fang is ensheathed by a fold of mucous membrane when the reptile is not in the act of biting. When the snake strikes, the fang is uncovered and enters the tissues, and by the contraction of the muscular wall of the poison bag its contents are injected into the tissues.

Venom. According to Mitchell and Reichert the poison of venomous reptiles contains a proteid substance known as globulin, and a peptone. It is thought by some investigators that the peptone is, more properly speaking, an albumin. The peptone and globulin, when injected, cause edema of the tissues and possibly sloughing. The capillaries are eroded, local hemorrhages occur, and the coagulability of the blood is destroyed. The part swells rapidly and is dotted with petechiæ. The swelling is either progressive, the parts breaking down and suppurating, or the swelling may gradually subside and finally disappear. The symptoms are represented by intense pains, vomiting, great prostration, dyspnea, rapid and feeble heart action, convulsions, collapse and death. In cases not so severe the symptoms, local and general, gradually abate and the patient recovers.

[illegible] the bite should be immediately [illegible] hemorrhage should be encouraged [illegible] excised and then thoroughly [illegible] carbolic acid, or by placing [illegible] with a lighted match. [illegible] for the purpose [illegible] amount of the poison [illegible] Strychnine [illegible] recommended [illegible] Treatment [illegible] antagonism [illegible]

CHAPTER VII.

SURGICAL DISEASES DUE TO SPECIFIC ORGANISMS.

These are anthrax, rabies, glanders, actinomycosis, erysipelas, tetanus, gonorrhea, tuberculosis, leprosy, and probably syphilis.

ANTHRAX. (MALIGNANT PUSTULE. WOOLSORTER'S DISEASE. MILZBRAND.)

Anthrax is an infectious disease caused by the bacillus anthrasis. The disease is common among sheep and cattle in all parts of the world, but especially so in Russia, Siberia, and China. All parts of the diseased animal contains the specific micro-organisms. Upon the death of an infected animal the exposed or buried carcass infects the surrounding soil and. according to Pasteur, the specific organisms are carried by earth worms from the soil to blades of grass and shrubs upon its surface. In this manner entire fields or pastures become contaminated for indefinite periods, and cattle or sheep in grazing upon these pastures become infected from the grass and shrubs eaten.

Man may become infected from the bites of insects, such as large flies which have been feeding upon the carcass of an infected animal, or by handling diseased hides, sorting infected wool, picking infected rags, or shoeing infected horses. Tanners, stablemen, wool-sorters and rag-pickers are those most frequently diseased. Infection usually occurs through some portion of the exposed skin, in anthrax usually about the face, hands or neck.

The germs having gained an entrance to the system through some slight wound, multiply and produce at first a red pimple. This is surmounted by a vesicle and surrounded at its base by a red, brawny inflammation. The vesicle ruptures leaving a dark, excavated slough or eschar. Around this eschar a row of new vesicles form while the inflammation spreads at the base. Suppuration is absent about the eschar and at times there is little or no pain. In other cases the wound is the site of a severe, burning pain. For two or three days after the appearance of the red pimple the disease remains localized, the bacilli being confined to the inflamed area. In some cases the condition does not go further than the local infection, the germs being sequestered and finally destroyed. In the great majority of cases, however, the disease is rapidly progressive and during the third day the proximal lymphatic glands become involved. Fever then makes its appearance and a typhoid condition of the system is developed. Exhaustion, coma and death end the scene, the patient scarcely surviving a week from the appearance of the first red pimple.

The *diagnosis* is made by considering the progress of the local condition and the occupation of the individual. The fact that there is primarily a red pimple, which itches and is soon converted into a vesicle; that the vesicle ruptures leaving an eschar which is surrounded at its base by an inflamed area; that other pimples and vesicles occur circumferentially and go through the same process; and that there is an absence of suppuration will ordinarily establish the diagnosis. If necessary, an examination of the fluid of the vesicle will show the specific bacillus of the disease.

The *prognosis*, under proper treatment, while the disease remains local, is good. If systemic infection has occurred there is practically no hope from any kind of treatment.

Local Treatment.—The inflamed area should be freely excised at the earliest possible moment, or while the infection is still local, and the wound cauterized by carbolic acid. A solution of carbolic acid, 1 to 20, should then be injected into the area directly surrounding the wound.

In Wisconsin a great many cases of anthrax have been treated without excision by injecting a solution of carbolic acid into the area surrounding the inflammation, and with most excellent results.

HYDROPHOBIA OR RABIES.

This is an infectious disease transmitted from animals to man.

Although no specific micro-organism has been found, it is generally conceded that the disease is of germ origin. Rabies is generally transmitted from animal to animal, or from animal to man, through the saliva of the diseased animal gaining access to a wound or abrasion. It is probably true that all the fluids and tissues of a diseased animal are capable of transmitting the disease. The disease occurs in dogs, cats and wolves and is transmitted by them to man. Not all persons bitten by rabid dogs develop hydrophobia. If the teeth pass through the clothing before reaching the skin, the saliva may be wiped off the teeth and the individual thus escape infection. It has also been shown that the disease may be conveyed by a dog suffering from rabies simply licking an abrasion upon the skin of a healthy individual. It is estimated by Roux that about fourteen per cent. of those bitten by rabid animals develop the disease.

RABIES IN THE DOG.—Rabies occurring in dogs is always transmitted from one dog to another by biting. After infection there is a period of incubation, usually lasting from three to six weeks. During this time the wound heals kindly and the animal seems well.

Two chief varieties of the disease have been described, the maniacal and the dumb.

In the maniacal the dog wanders about for a few days, frequenting dark corners and eating straw, hay, earth and stones. This period lasts two or three days, and is followed by a stage of frenzy in which the dog races about, snapping at and biting every animal and person that comes in his way. This period lasts two or three days, and is followed by paralysis of the lower jaw and limbs. The paralytic stage continues about a day. The entire course of the active disease is completed in from five to six days, when death usually comes in convulsions. During the entire course of the affection the dog's mouth is filled with a ropy, tenacious mucus, which he vainly tries to

rid himself of. The dog's ordinary, sharp, ringing bark is changed into hoarse howl, and after the advent of paralysis the ability even to howl is lost.

In dumb rabies the state of frenzy is absent and the course of the disease is somewhat shortened.

HYDROPHOBIA IN MAN.

In man the period of incubation may be but a few days or one or mo years. It is seldom less than two weeks and usually about six weeks. bites about the face the period of incubation is somewhat shorter. Duri this period the wound heals kindly and the patient feels well. At the e of the incubative period comes the premonitory stage, lasting one or tv days, during which time the scar becomes red and painful, while the patie suffers from headache, restlessness, insomnia, mental depression, and pe haps slight fever. There is an aimless wandering about, with mental fo bodings of coming disaster. The skin and especially the senses are hype sensitive. At the end of this stage the disease becomes fully developed.

Stage of Excitement.—Among the first symptoms of this stage a convulsive contractions of the tongue, neck and pharynx. The contractio are spasmodic in character and tend to become general. They are excit by the slightest disturbance, such as a draught of cold air, a slight noise, flash of light, an attempt to swallow, or the noise of running water. T respiration becomes irregular and at times a peculiar hiccough is produc by contraction of the diaphragm, which has been likened to the barking o dog. During this stage there is agitation, even great terror, but the mi remains clear. The convulsive paroxysms last from one-half hour to o hour, when there is an intermission of one or more hours, during whi the patient is more comfortable, may possibly rest and even take food, a then the convulsions return. The stage of excitement lasts from one three days, and during this time death may occur from exhaustion or fro asphyxia. If the patient survives this period the stage of paralysis supe venes, during which the convulsions become less pronounced and the patie more tranquil; he may be able perhaps to swallow fluids, but the paralysis a rapidly ascending one and the sufferer dies of cardiac failure or fro pathological changes in the medulla.

There are pathological evidences of acute inflammation in t medulla, including the centers of the ninth, tenth and eleventh nerves. T vessels are thrombosed, the connective tissue filled with leukocytes and t nerve fibers and ganglion cells are often in a state of degeneration. T brain and spinal cord are hyperemic, while the pharynx, fauces and neig boring lymph glands are congested.

Treatment. *Prophylactic.*—The end desired is to rid the wound its poison before it can enter the system. For this purpose bleeding shou be encouraged, and this may be done by "milking" the adjacent tissues. the wound is a punctured one it is best to open it by incision and th thoroughly cauterize the wound, preferably with pure carbolic acid.

For the method of preventing hydrophobia after the wound has hea ve are indebted to M. Pasteur. He established the fact that the inje an attenuated virus in increasing doses, and in increasing strength

The *dog* [illegible] had been bitten, [illegible] the injection [illegible] dition and the [illegible] a red pimple, [illegible] is conveyed [illegible] emulsifying [illegible] of a dog [illegible] and then [illegible] vesicle ruptures [illegible] inflamed area [illegible] of a rabbit [illegible] go through the [illegible] appears [illegible] will ordinarily [illegible] fluid of the [illegible] caustic [illegible] as the result [illegible] is good. [illegible] from any [illegible]

Local [illegible] earliest [illegible] cauterized [illegible] this [illegible] be injected [illegible] the [illegible] a [illegible]

[illegible] instituted [illegible] is very [illegible] given per rec- [illegible] that they [illegible] In case [illegible] but [illegible] stakable [illegible] es not [illegible] longer. [illegible] disease if [illegible] immediately [illegible] ex- [illegible]

[illegible] and the [illegible] horses and [illegible] This is a [illegible] The bacilli [illegible] of tuber- [illegible] and has a [illegible] glanders and [illegible] other horses [illegible] of the [illegible] usually comes in [illegible] dog's mouth is filled [illegible]

PATHOLOGY.—The micro-organisms become implanted within the mucous membrane and set up a chronic inflammation, with the formation of nodes made up of granulation tissue. These nodes readily break down into ill-conditioned ulcers. The ulcers are slowly progressive, extending into and destroying the adjacent tissues and bones. After some months irregular nodes (farcy buds) appear within or beneath the skin or within the muscles, and these may break down into progressive ulcers.

SYMPTOMS AND COURSE.—The first symptoms of the disease in a horse are those which might attend a severe cold in the head; there is a thick, tenacious, whitish, mucus discharged from the infected nostril. This clings to the tissues about the nostril and is only gotten rid of by the vigorous snorting of the animal. This secretion is increased when the horse is driven, but when he is quiet in his stall the amount of secretion is often very little. The discharge contains the organisms of the disease. The horse tires easily and sweats profusely when driven. His coat looks dull and is lacking in luster. He becomes weak, loses flesh and finally dies of exhaustion.

GLANDERS IN MAN.

Man is not ordinarily susceptible and is rarely infected by the organism of glanders. Stablemen often care for and drive glandered horses for months without any special precaution, and yet without taking the disease. In man infection is usually through some scratch or abrasion about the border of the nostril or in the nose. There is then a period of incubation lasting for one or two weeks. The process is much more acute in man than in horses.

PATHOLOGY.—The bacilli set up an acute inflammation with nodular swellings, which soon break down into phagedenic ulcers. The nodules are made up of granulation tissue. The process spreads rapidly to the adjacent structures by contiguity of tissue, through the lymphatics, and through the veins by emboli. The nodular swellings and ulcers are usually situated within or about the borders of the nose, although they may occur in the bronchial tubes, gastro-intestinal canal and internal organs. Aside from the nose, the eyes, mouth and fauces may be attacked.

The progress of the disease is usually acute, although occasionally it is chronic.

In acute cases there is high fever, severe pain, and rapidly progressive prostration. The symptoms of the disease are those of a rapidly spreading infection. In the chronic cases all of the symptoms are less pronounced, while the ulcers are fewer and less progressive. In some cases the symptoms may gradually abate, the ulcers heal, and the patient recover. Acute cases usually terminate fatally in one or two weeks.

Acute glanders in man must be differentiated from acute suppurative processes, and chronic glanders from syphilitic ulcers. The fact that the patient has had to do with glandered horses should lead one to make a careful microscopical examination of the nasal discharge.

TREATMENT.—In the treatment the nodules should be opened, curetted, and cauterized, and the ulcers curetted and asepticized. The system should be supported by proper nourishment and the patient treated symptomatically.

ACTINOMYCOSIS BOVIS—RAY FUNGUS.
ACTINOMYCOSIS HOMINIS—STREPTOTHRIX ACTINOMYCES.

(Fig. 93.)

The specific ray fungus of actinomycosis was first recognized by Liebert, in 1887; and as occurring in cattle by Bollinger in 1877, and as affecting man, by Israel, in 1882.

The fungus, as it appears in the tissues, is in the form of small, yellowish, reddish or green unctious granules. These granules when pressed between a cover glass and slide, and viewed through a microscope, appear as a more or less tangled mass of radiating threads, often having clubbed extremities.

The organism, according to Pasteur, passes its saprophytic existence on blades of grass and the beards of cereals. Infection occurs both in animals and man through abrasions and wounds in the mucous membrane of the mouth, from the chewing of grasses and cereals. It is thought that these bearded cereals wound the mucous membrane of the mouth and thus lead to the infection. Infection may also occur through a wound of the skin, in the gastro-intestinal canal, or in the respiratory tract from inhalations. The disease is quite common in cattle and is known as "lumpy jaw" or "big jaw." The disease has also been known to occur in horses, swine, and dogs.

ACTINOMYCOSIS HOMINIS.—Actinomycosis seems to be endemic in certain places. It is seen more especially among farmers and millers. While the disease occurs most frequently about or beneath the lower jaw, it has been recognized in the throat, tongue, esophagus, intestinal canal, respiratory tract, and in the central nervous system.

PATHOLOGY.—The fungus on gaining entrance into the tissues produces a chronic inflammation with the production of granulation tissue. Primarily, there is an exudate of lymphocytes and leukocytes, following this a proliferation of the connective tissue cells and the formation of granulation tissue. In this granulation tissue the yellow or sulphur-colored bodies are to be seen. The process is slowly progressive, the granulation tissue increases, invades the adjacent structures and produces a hard, nodular condition of the skin and subcutaneous tissues. There is seldom a large tumor produced, but rather an induration of the affected structures. It spreads laterally invading new portions of the skin and subcutaneous and submucous structures, and often all of the tissues, excepting the bone, from the mucous membrane of the mouth to the skin, are infiltrated. The fungus is not pyogenic but pyogenic infection often occurs. The pus, when present, contains the yellow-colored granules which are pathognomonic of the disease. The disease though slowly progressive does not, for a long time at least, when external, affect the patient's health or well-being.

The *diagnosis* is to be made by considering the occupation of the individual; the situation of the chronic infection (usually beneath the jaw or within the mouth); also by noting the thickened, leathery, nodular condition of the skin and subcutaneous tissues; the slow, progressive character of the inflammation; the fact that foci of suppuration occur in the pus of which the sulphur-yellow granules are to be seen; the further fact that the health and well-being of the individual, at least for many months, is

not interfered with, and finally by the recognition in the pus, and even in the granulation tissue, of the specific fungus of the disease. It was for a long time thought that the granulation tissue was sarcomatous, in consequence of its progressive character and in consequence of the round cells of which the tissue was composed.

PROGNOSIS.—About seventy per cent. of the cases of abdominal actinomycosis, and ninety per cent. of lung actinomycosis, prove fatal in spite of treatment. In circumscribed lesions about the neck, mouth, and tongue the prognosis is usually good.

TREATMENT.—Internally iodide of potash has been extensively used with gratifying results. It should be given for a short time and then interrupted, and then given again. The use of the X-ray may be combined with the iodide. Bevan has recommended the use of the copper sulphate internally in doses of one-fourth to one grain, three times a day, and irrigations with the same substance in solution when the case is rebellious to the iodide treatment.

In accessible areas of actinomycosis, which do not yield to internal and X-ray treatment, surgical measures should be resorted to. The surgical treatment consists in the excision of the infected tissues as far as the anatomical relations of the part will permit, and then in thoroughly curetting all of the remaining foci of granulation tissue. These pegs or walls of granulation tissue often extend between the anatomical structures, and can be readily followed up and removed by the curette. The wound is then treated antiseptically, and if the process recurs the curettage is repeated.

MADURA FOOT.

This disease is due to the streptothrix maduræ, which apparently belongs to the same family as the ray fungus. The organism occurs as yellow or black granules and was first recognized by Ballingall, in 1885, in a discharge from a diseased foot. His observations were later confirmed by Carter, Paltauf, and Vincent. The disease is usually confined to tropical and sub-tropical countries, although a few cases have been observed in this country, especially in Texas. Nothing is known of the saprophytic existence of the fungus, although the infection seems to occur through a wound or abrasion. In one form of the disease the granules are of a pale, yellowish color and in the other black. These colored granules are readily recognized in the tissues. In the yellow there is a mass of interwoven filaments. These are non-septate and the peripheral ones have bulbous ends. The organisms of the melanoid are coarser, septate and have the rosette form.

The disease occurs in the plantar or dorsal surface of the foot and in the hand and produces a slowly progressive, nodular swelling. The process invades and destroys the soft structures and even the bones.

The diseased structures are made up of granulation tissue, composed of lymphoid, epitheloid, and giant cells. The nodules break down and suppurate.

The disease being slowly progressive, the foot or hand becomes swollen while the leg or arm is weak and atrophied. The patient finally dies from exhaustion.

DIAGNOSIS.—This is made by taking into consideration the climate, the situation of the disease, the slow, progressive character of the inflammation and by the recognition of the fungus masses or mycetoma.

TREATMENT.—On theoretical grounds the treatment should correspond to that of actinomycosis: iodide of potash internally, combined with the X-ray externally. Surgically, the treatment consists of excision of the diseased area or incision followed by vigorous curettage and cauterization, or amputation.

ERYSIPELAS.

Erysipelas is an acute infectious disease due to the streptococcus erysipeletous. There has been a good deal of discussion among bacteriologists as to whether the streptococcus of erysipelas and the streptococcus pyogenes are one and the same organism. Microscopically, and on culture media, they are not to be differentiated, although it is claimed that the organism of erysipelas is slightly larger. There is seemingly, however, a marked difference in their effect upon the tissues, in that the streptococcus erysipelatous almost never produces pus formation, while the streptococcus pyogenes, under favorable conditions, always does.

ETIOLOGY.—The important factors in the production of erysipelas are: first, the specific micro-organisms, and second, a wound through which they gain an entrance to the superficial lymphatics of the skin or mucous membrane. Finding a lodgment, they multiply rapidly. The symptoms of the disease are produced by the absorption of the toxins, which are formed during the growth, multiplication, and death of the bacteria. An attack of erysipelas, after a brief period of immunity, renders the patient more susceptible to subsequent attacks.

Persons who are weak and debilitated from alcoholism, diabetes, albuminuria, gout, rheumatism, bad hygienic surroundings, care, anxiety or worry are especially susceptible to the disease.

SYMPTOMS AND CLINICAL COURSE.—Erysipelas is usually ushered in with a chill, which is followed by a high fever. Following the occurrence of the fever there appears at the site of the infection, and this may be through an unobserved scratch or abrasion or a small ulcer just within the nostril, a rapidly-spreading, bright or dark-red blotch upon the skin. This inflamed area is elevated, thickened, and brawny and has a very distinct but irregular border. It is also the site of a burning, itching pain which is especially severe when the process affects the face or scalp.

In the most typical cases the inflammation continues to spread for from thirty-six to forty-eight hours, during which time the fever remains high, often reaching 102 to 104 degrees F. The fever then remits for from twelve to twenty-four hours, while the redness and induration fade in part from the inflamed area, and vesicles or bullæ appear upon its surface. A second exacerbation then occurs with a return of fever and a rapid extension of the area of inflammation. These exacerbations and remissions continue to recur for one, two, or more weeks, when in favorable cases the disease gradually declines, the fever becoming less marked, and the spread of the inflammation less pronounced.

In any but the most severe cases the disease will reach its height within a week or ten days, when there will be a progressive improvement.

In mild cases but a small area may be involved in the inflammation, while in severe cases the process may spread over the major portion of the surface of the body.

There is usually marked nervous disturbance during the course of the disease, with insomnia and even delirium during the height of the fever. A marked characteristic of the disease is that, with each exacerbation and spread of the inflammation, the part previously affected gradually returns to the normal, so that at no time is there ever any great extent of surface actually inflamed. There is a vigorous desquamation of the superficial epithelium as the part returns to the normal.

During the course of the disease, especially if this is prolonged, and in consequence of the high fever, toxemia, pain, loss of sleep, and inability to take food, the patient becomes greatly weakened and much reduced in flesh. During early convalescence the temperature is often subnormal in consequence of the weakness. The pulse is weak and rapid and the patient anxious and careworn.

VARIETIES—FACIAL ERYSIPELAS.—In this form infection usually occurs at the border of, or just within, the nostril and through some small hidden ulcer or slight abrasion. From this point the bright-red, inflammatory area extends rapidly to the cheek, eyelids, and across the bridge of the nose to the opposite side of the face. The tissues about the eyes become enormously swollen, obliterating the normal facial expression and often closing the eyes. The inflammation extends into the scalp and often down the back and arms. Vesicles and bullæ readily form. With the decline of the inflammation desquamation is marked, delirium is often present in facial erysipelas, and it may be so extreme that the patient will require forcible restraint. The delirium is due to the high fever and the irritation of the toxins upon the sensitive nervous centers. With the subsidence of the fever and the arrest of the inflammation, the delirium disappears.

ERYSIPELAS NEONATORUM.—This variety of erysipelas makes its appearance at the site of the umbilicus in new-born infants. The inflammation spreads over the abdomen and thighs, the fever is high, the prostration great and the condition of the infant grave. The umbilical veins may become infected and the process spread to the liver.

ERYSIPELAS OF THE MUCOUS MEMBRANES.—This form occurs occasionally in the throat, attacking the tonsils, fauces, and soft palate. The process may extend to the pharynx and epiglottis. The parts inflamed are greatly swollen and of a dusky red color. The voice is often husky. The mucous membrane of the vagina and rectum may also be attacked. In all of these cases the process may be an extension from an adjacent or remote infection, or it may occur as a primary infection. The so-called phlegmonous erysipelas and phlegmonous cellulitis are often classed as forms of erysipelas. In the former there is a rapidly spreading suppurative inflammation of the skin and subcutaneous tissue, while in the latter the process is confined to the subcutaneous connective tissue. In both of these cases the inflammation spreads rapidly, while large quantities of pus are formed with necrosis of connective tissue and often of the skin. It would seem that these infections more properly be classed with the suppurative inflammations than vsipelatous processes, as in the latter pus is very rarely formed.

CURATIVE INFLUENCE OF ERYSIPELAS.—Occasionally sarcomatous growths have disappeared after an attack of erysipelas. A knowledge of this fact led Fehleisen to recommend the injection of cultures of the streptococcus erysipelatosus into sarcomatous tumors. The subject was further studied by Coley, who recommended the injection of the toxins of the streptococcus of erysipelas with the toxins of the bacillus prodigiosus. Some success has attended these injections. Indolent, epitheliomatous and lupus ulcers have also been known to heal rapidly after an attack of erysipelas.

DIAGNOSIS.—There is usually no difficulty in making a diagnosis of erysipelas. Its origin at the site of some wound or abrasion; its sudden onset and high rate of fever; the rapidly spreading, inflamed area with its red, elevated, brawny surface and zig-zag border; the exacerbations and remissions; the vesicles, bullæ and desquamation, make a picture which is distinctive of the disease.

PROGNOSIS.—The prognosis of erysipelas is usually favorable. It is stated by Osler that about seven per cent. of the cases terminate fatally.

TREATMENT.—Ten c. c. of anti-streptococcic serum injected subcutaneously will at times arrest the spread of the inflammation almost at once. In other cases it has no effect upon the inflamed area or the course of the disease. Under present conditions its use is to be recommended during the first days following the infection. Locally, the treatment is antiseptic. A ten per cent. to twenty-five per cent. ichthyol ointment rubbed into the inflamed area, night and morning, is often beneficial, or antiseptic compresses of carbolic acid or corrosive sublimate solution may be applied. Tincture of iodine has been extensively used as a local application. Strips of adhesive plaster drawn firmly over the healthy skin just beyond the inflamed area have been used. The purpose of these strips is to obliterate by pressure the lymphatic channels and thus arrest the spread of the disease. The constitutional treatment should be supportive. The tincture of the chloride of iron and quinine are often given. Morphine may be necessary for the control of pain, while chloral and the bromides are useful to procure sleep and for the control of restlessness and delirium. Liquid food should be given at frequent intervals.

TETANUS.

(Fig. 87.)

Tetanus is an infective disease due to the bacillus tetani. The bacillus is anaerobic and is found especially in garden soil and in the dust of the street. It has also been demonstrated upon the hands of laborers and is usually present in the feces from horses, and occasionally in those from man.

The bacillus is one of the surgical, spore-bearing kind, and appears in the form of slender threads, one end of which is expanded in the form of a drumstick and contains the spore.

PREDISPOSING CAUSES OF TETANUS.—It is stated by Anders and Morgan that vigorous health and a nervous temperament are factors in the production of tetanus. Bad hygienic conditions, such as overcrowding in hospitals and barracks, in time of peace or war, are favoring circumstances. Heat is the most pronounced predisposing factor. The
tropical countries and is most prevalent in this

of summer. The heat seemingly increases the virulence and activity of the germs. Especially is this true if the hot days are followed by cold nights.

CAUSES.—The bacillus of tetanus usually gains an entrance to the system through some scratch or abrasion upon the skin, although it is possible that they may be taken in with the food or inspired with the air. The wounds most suitable for their growth are punctured, contused, lacerated, and gunshot. In the hidden recesses of these wounds the conditions are most favorable for the growth of the germs. Wounds by foreign substances which come from the soil, such as nails or slivers of wood, and any traumatism which carries into the tissues portions of garden soil, and wounds caused by blank cartridges, the wads of which contain horse feces, are extremely liable to be followed by tetanus.

The bacilli, when they have gained an entrance to the subcutaneous tissue and find conditions favorable for their growth, multiply and secrete toxins. The toxins are the active factors in the production of the disease, and are found in the motor nerves, spinal cord, and central ganglia. It has been demonstrated by Marie and Morax that the toxins reach the central ganglia through the motor nerves. From an infected wound these toxins are diffused through the adjacent tissues and some of them reach the muscle end apparatus of the motor nerves. The major portions are taken up by the lymphatics, reach the general circulation, and are sent back to the capillaries, where they come in contact with the muscle end apparatus of the motor nerves. They then ascend these nerves to the spinal cord and central ganglia, where by their irritation upon these structures tetanus is produced. The bacilli are principally found in the area immediately surrounding the wound. They have also been demonstrated in the blood, distant organs, and in the urine.

PERIOD OF INCUBATION.—This is very variable and may be but the fractional part of a day or extend over months. In the great majority of cases the symptoms make their appearance within two weeks. In 858 cases tabulated by Anders and Morgan the period of incubation in 194 cases, or 22.3 per cent., was five days or less, with a mortality of 58.8 per cent. In 394 cases, the disease developed in from five to ten days, with a mortality of 63 per cent.; 148 cases gave an incubation of from ten to fifteen days, with a mortality of 42 per cent.; 98 cases developed in from fifteen to twenty-five days, with a mortality of 40 per cent.

DURATION OF THE DISEASE AND MORTALITY.—Out of 870 cases, 330 ran their course in less than five days, with a mortality of 81.4 per cent.; 231 cases lasted from five to ten days, with a mortality of 65 per cent.; 91 cases continued for from ten to fifteen days, with a mortality of 27 per cent.; 211 cases continued over fifteen days and had a mortality of only 8.5 per cent.

SYMPTOMS AND COURSE.—Usually the first symptom in the occurrence of tetanus is a stiffening or contraction of the masseter muscles, making it difficult or impossible to open the jaws (trismus). In some cases the muscles primarily implicated are those in the immediate vicinity of the wound. From this point the spasms spread out over the entire muscular system. Beginning in the muscles of the jaw, the process soon extends to those of the neck and back, producing a stiff neck and back, and from here the extremities become implicated.

The muscular contractions are tonic and usually occur in the form of convulsions, which may affect a limb or the major portion of the body. The contractions are very painful and are so violent as to often cause rupture of a muscle, or, in cases of violent contractions of the masseter muscles, the crushing of the teeth. More than one hundred convulsions have occurred within a few hours.

When the muscles of the back are implicated, the condition known as *opisthotonos* may be produced, that is, the body is arched strongly backwards. The body may be bent forwards, when the condition is known as *emprosthotonos,* or it may be bent laterally, *pleurosthotonos.*

Throughout the course of the disease the mind usually remains clear and the temperature is not high. The convulsive attacks in cases less severe are lighter, further apart, and, finally, they may cease altogether. In cases which go to a fatal termination death may be caused by exhaustion, as the result of the terrible contractions, severe pain, loss of sleep and inability to take food, or as the result of the interference with the centers of respiration and circulation. After death the temperature has often risen to 110 or 112 degrees.

Varieties of Tetanus—Chronic Tetanus.—In this form the incubative period is usually two weeks or more. The convulsions are not severe, while the intervals are long. There is an absence of fever.

Tetanus Neonatorum.—This form occurs after birth as the result of infection at the umbilicus. The mortality is usually very great.

Tetanus Hydrophobicum.—This variety has been so named in consequence of its similarity in some slight extent to hydrophobia. In this form there are usually spasms of the muscles of deglutition and delirium.

Cephalic Tetanus.—In this variety, infection has occurred within the area of distribution of the cranial nerves. There is usually facial paralysis. The incubation period is short and the convulsions often violent.

Diagnosis.—The season of the year, the kind of wound, how produced and the possible nature of the infection should aid one materially in making a diagnosis. In doubtful cases a bacteriological examination of the secretions of the wound should be made. The condition is readily differentiated from stiffness of the jaws due to dental irritation and from inflammatory infections about the face. It is to be differentiated from hysteria and rheumatism, yet hysteria and rheumatism are not likely to lead one into error. In hydrophobia the nature of the wound, how received, and the fact that the muscles of deglutition are affected and not those of the jaws, and that the contractions are clonic instead of being tonic as in tetanus, will aid one in making a diagnosis.

Strychnin poisoning presents some similarity to tetanus infection in that the contractions are tonic and violent. In pronounced poisoning, however, there is more relaxation between the attacks, and the hands are usually affected, which is not the case in tetanus. The fact that the patient in one case has taken strychnin and in the other had received a wound should be of diagnostic value.

Prognosis.—In 870 cases recorded by Anders and Morgan there were 464 deaths, or a mortality of 53.3 per cent.

TREATMENT.—*Prophylaxis.* All punctured, contused, lacerated and gun-shot wounds, and especially those received during the heat of summer and under favoring conditions, should be thoroughly asepticized and swabbed out with strong tincture of iodine, or 1 to 10 carbolic acid solution, followed by alcohol, or by a strong solution of mercury and then lightly packed with iodoform gauze. This cleansing should be repeated daily. If there is reason to suspect infection by the germs of tetanus, or if the bacteriological examination shows their presence for at least three days, 10 c. c. of antitoxic serum should be injected into the tissues immediately surrounding the wound. At the same sitting 10 c. c. of the serum should be injected into the median basilic vein. These injections should be repeated daily.

Experience seems to have demonstrated that the subcutaneous and intravenous injections of serum following the injury and before the occurrence of symptoms will, in nearly every case, prove preventive. If the disease has already made its appearance in the form of muscular contractions, the condition is a much more serious one. It has been demonstrated that the toxins are to be found in the motor nerves, spinal cord and central ganglia, where they are practically immune to subcutaneous or intra-venous injections of antitoxic serum. The serum, when injected subcutaneously, is quickly excreted or destroyed and the same is true to a less extent when injected intravenously. The best effects are produced when the serum is injected directly into the motor nerves which contain the toxins. In cases in which infection has occurred through a wound upon an extremity, as the hand or foot, it has been recommended and successfully practiced by Rogers and others, to expose by dissection the brachial plexus in the axilla (in the former case) and inject into each of the motor nerves, the musculo-cutaneous median, musculo-spiral, ulnar, and circumflex, from ten to thirty minims of the serum. A fine needle is used attached to an aspirating syringe, and sufficient serum injected to swell the nerve to two or three times its normal size. These injections are repeated every day while the convulsions last. In case the wound is upon the foot the anterior crural and sciatic nerves are exposed and injected. In severe cases the cauda equina may be injected by inserting a long needle between the second and third lumbar vertebra and moving it around until the legs are seen to twitch, showing that the nerves have been injured, when from ten to twenty c. c. of the serum are injected directly into the tissues. The nerves being bruised and wounded the antitoxins readily enter them when injected in this situation. In cases in which cyanosis is present, showing that the vital centers of circulation and respiration are in danger, the spinal cord in the upper dorsal region, or lower cervical, have been injected by Rogers with success. A long needle is passed between the sixth and seventh cervical or upper dorsal vertebra and pushed directly through the cord when from ten to thirty minims of the serum are injected into the tissues of the cord.

In cases where the symptoms are already manifest the method of procedure should be as follows: First inject ten c. c. of the serum directly into a vein, and then an equal amount into the subcutaneous tissue surrounding the wound. The motor nerves as far distant from the wound as possible should then be exposed and injected. If the case is severe, the cauda equina may be injected, and possibly the lower cervical or upper dorsal cord. After

this the wound is thoroughly opened, so as to give free access to every recess, when all necrosed or dead tissue is cut away and foreign material removed and the wound thoroughly asepticized. The wound is then swabbed out with tincture of iodine, carbolic acid, or bichloride of mercury and lightly packed with iodoform gauze. By this method Rogers treated seven desperate cases and saved four.

GONORRHEA.

(Fig. 89.)

This is a specific and contagious disease implicating, as a rule, the mucous membrane of the genito-urinary tract. The infection may also occur upon the conjunctiva, mucous membrane of the rectum, and possibly on the Schneiderian membrane of the nose.

Gonorrhea is due to a specific micro-organism, the gonococcus, which grows readily on acid media. The organism is in reality a diplococcus, the germs usually occurring in pairs like two seeds lying side by side, their opposing surfaces being slightly flattened.

While the diagnosis of gonorrhea can ordinarily be made from the symptoms and history of the case, an absolutely positive diagnosis can only be made by discovering the micro-organism of the disease. The following reagents have been recommended for this purpose:

First—To 100 cubic centimeters of a two per cent. solution of carbolic acid in distilled water is added five cubic centimeters of analine oil, drop by drop, the bottle being shaken after each addition. The solution is then filtered through a moist filter paper and ten cubic centimeters of alcohol added, and to this add eleven cubic centimeters of saturated alcoholic solution of either gentian-violet, fuchsin, or methylene-blue.

Second—*Gram's Solution.*

Iodine,	1 part
Potassium Iodide,	2 parts
Water,	300 parts

Third—For counter-staining, a solution of Bismarck brown in twenty per cent. carbolized water is employed.

Fourth—Ninety-five per cent. alcohol.

METHOD OF PROCEDURE.—The region about the meatus is cleansed with a pledget of cotton moistened in alcohol and water. The urethra is then stripped so as to bring a drop of pus to the meatus. A clean cover-glass is then touched lightly to the drop, allowing a portion to adhere. A second cover-glass is then placed lightly upon the first and drawn off obliquely for the purpose of producing an even smear. Both smears are then left to dry in the air. For the purpose of fixing the smear, each cover-glass is passed quickly over a gas flame, the smear side up. The smear is stained by placing a few drops of gentian-violet solution on it for a few moments. The excess of the solution is then washed away and the cover-glass dried between filter paper. The specimen is mounted in balsam and examined with a one-twelfth oil immersion lense. By this process the pus, epithelial cells, gonococci, and other micro-organisms are stained a violet color.

If one is desirous of being absolutely certain regarding the micro-organisms, Gram's method may be added to the above. In this case, the second

cover-glass is stained for from two to five minutes as before, the excess of staining-fluid is then washed off, and the cover-glass is immersed in Gram's solution for three minutes and then washed in ninety-five per cent. alcohol until the specimen is decolorized. The alcohol is washed away with water and the specimen dried and mounted in balsam. In this specimen the gonococci, epithelial and pus cells are unstained, while all the other micro-organisms are stained violet.

The important characteristics of the gonococci are that they appear in large numbers within the protoplasm of the cells in acute cases and in the form of flattened diplococci. A person having been exposed to infection and having the symptoms of acute gonorrhea, if one finds numerous diplococci within the protoplasm of the cells, the diagnosis may, under ordinary conditions, be considered established.

When the acute stage has passed, the gonococci are not so numerous nor so readily found, because they have penetrated the deeper layers of the epithelium, and are not readily cast off. Repeated examinations may be necessary for their discovery. A favorable time is in the morning after a night of dissipation, or after a hearty meal of stimulating food or after a ride on horseback.

The discharge containing the gonococci may come from the anterior urethra and show at the meatus, or it may come from the posterior urethra and appear just before the first urine is passed, or in the second portion. It may come from the bladder with the last urine passed or from the seminal vesicles or prostate after milking the prostatic urethra.

ACUTE GONORRHEA IN THE MALE.

Infection is nearly always due to sexual intercourse, during which the virulent pus of the female enters the male urethra. This method of carrying the germs is called mediate contagion. It is often claimed that gonorrhea is acquired by immediate contagion, that is, by coming in contact with infected clothing or seats in water-closets; but this method of infection must be very rare because the organism must enter the urethra in order to produce the disease.

According to Bumm and Baumgarten, only mucous surfaces possessed of epithelium or epithelium capable of this change are liable to infection. This would render immune the bladder and vagina of adults.

Incubation.—This period lasts for from three to six days before the first symptoms make their appearance. It may, however, have a duration of but a few hours or be prolonged for weeks. During incubation the germs penetrate the deeper layers of epithelium and produce some soreness and inflammation so as to excite attention.

Prodromal Symptoms.—Erections are frequent during this stage, with weight and tension in the penis, and itching and sensitiveness at the meatus, while the attention of the individual for a day or two is almost constantly fixed upon the organ.

Inflammatory Stage.—During this stage the lips of the meatus are red, swollen, and everted. The swelling of the anterior portion of the urethra may also be so considerable as to render the discharge of the urine difficult, while the stream is usually forked and twisted. In severe cases the

foreskin becomes œdematous and the urethra very tender and nodular. The nodules and cords are due to infection in the lymphatic vessels, glands, and follicles.

The Discharge.—The discharge is at first scanty and of a whitish color, later it becomes more abundant and yellowish from the large amount of pus. At the height of the attack the discharge is often bloody and, after urinating, a few drops of pure blood make their escape. As the disease declines the amount of discharge lessens and becomes thinner, whiter, and is made up largely of mucus. In anterior urethritis the discharge makes its appearance at the meatus. In posterior urethritis, the discharge never appears at the meatus in consequence of the tonic contractions of the compressor urethral muscle. The discharge in this case remains in the posterior urethra or, if profuse, flows backward into the bladder. Pus from the posterior urethra may be detected by washing out the anterior urethra with a small catheter and having the patient pass his urine in two portions. If the amount of discharge is small, it will be washed out with the first urine, while the second portion will be clear. If the second portion is cloudy, and cystitis can be excluded, the cloudiness is due to the discharge from the posterior urethra flowing back into the bladder.

Ardor Urinæ.—Painful urination is usual during the acute stage of gonorrhœa. The pain may be felt at the meatus along the entire course of the pendulous urethra. The pain may be burning or stabbing in character and is caused by the acid and concentrated urine passing over the inflamed and very sensitive mucous membrane.

Painful Erections.—These are at times the cause of very great distress, even before the discharge makes its appearance. Frequent and long continued erections are common when the inflammation is well established. They are often so painful as to prevent the patient from sleeping. The erections are caused by the irritation and increased blood-pressure acting upon the inflamed mucous membrane. The pain is caused by the dragging of the engorged cavernous bodies upon the inflamed and sensitive mucous membrane. The erections are most frequent at night, while the pain is most severe along the urethra.

Chordee.—When the inflammation is very severe, chordee develops. This is a bending of the organ during erection and is attended with most atrocious pain. The curve or bending is usually downwards, but it may be lateral or upwards. The bending is due to the inflammation extending to the submucous tissue and trabeculæ of the spongy portion and filling the intertrabecular spaces with a plastic exudate which prevents their engorgement with blood. In case the inflammation and plastic exudate affect the cavernous bodies, the curve will be upwards, and when only one of the cavernous bodies is implicated the bending will be to that side.

An anterior acute urethritis seldom remains confined to this part of the urethra, but extends to the posterior urethra during the first or second week of the attack. The symptoms of posterior urethritis are often so slight as not to attract attention. The second portion of the urine, however, is likely to be clouded. In acute cases of posterior urethritis the symptoms are well marked. There is painful, urgent, and frequent urination. In the normal condition, when the bladder becomes partially distended, the internal

vesicle sphincter dilates and the urine comes in contact with the prostatic urethra, and although this occasions a desire to urinate, it may be controlled for hours without discomfort. In cases of acute posterior urethritis the prostatic urethra is inflamed and hyper-sensitive and, when the urine comes in contact with it, the desire to urinate is uncontrollable. The patient at times can scarcely wait a moment. Pus in the second portion of urine passed, if there is an absence of cystitis and pyelitis, is indicative of posterior urethritis.

The most pronounced complications in posterior urethritis are epididymitis prostatitis, vesiculitis, and cystitis. In posterior urethritis, there is often hematuria, a few drops of pure blood being passed with great pain at the end of each urination. A bearing-down sensation due to muscular spasm is often very annoying. Aside from this, there are tickling, burning, and shooting pains in the deep urethra. In posterior urethritis erections are unusual.

THE COURSE OF ACUTE GONORRHEA IN THE MALE.—Usually the symptoms increase for two weeks and then remain stationary for two or three weeks, when they gradually decline. In favorable cases from six to eight weeks will pass before the discharge disappears. In exceptional cases recovery may occur in ten days or two weeks, and in other cases the discharge runs into chronic gleet and may continue for a year or more.

Among the constitutional symptoms are fever, loss of appetite and strength, and anæmia. The complications in the acute stage are balanitis, balano-posthitis, phimosis, and paraphimosis. In the stationary stage, periurethritis and lymphangitis are not infrequent.

PROGNOSIS OF ACUTE GONORRHEAL URETHRITIS.—The inflammation in acute cases runs its course in from five to eight weeks if properly treated. In other cases, and especially if complications arise, the process runs into chronic gleet, with occasional subacute attacks. This is especially liable to occur in rheumatic and cachetic conditions of the system.

TREATMENT OF GONORRHEA IN THE MALE.—*Prophylaxis.*—The only reliable means of preventing infection is the wearing of a cover, followed by washing and irrigating the glans by a full stream of water. Many persons who are constantly in the habit of exposing themselves, inject a carbolized solution, or a solution of protargol, the former of the strength of one per cent. and the latter of the strength of one grain to the ounce of water.

Abortive Treatment.—There are two methods of treatment which are in vogue at the present time for the purpose of aborting gonorrhea. One of these is the injection of a strong solution of silver salts, the other is the irrigation of the canal with dilute antiseptic solutions.

The Use of Strong Solutions of Silver Salts.—After infection, the gonococci remain for several days confined to the superficial layers of the epithelium and can often be destroyed by the use of a strong solution of silver salts. This method is only applicable during the first few days following infection, that is, while there are no more marked symptoms than tickling at the meatus, accompanied by a slight discharge of mucus. A swollen meatus with everted lips, congested glans and painful urination are contra-indications for this treatment. The method may be carried out as follows: After urinating, ten to twenty drops of a four per cent. solution

of eucaine are injected into the urethra, then one drachm of the solution of protargol of the strength of five grains to an ounce is injected and allowed to remain for three minutes. These injections may be repeated every hour, and each time the ounce bottle which contains the solution becomes half empty, it is filled with distilled water. By this means, the injections are weakened from day to day. If these injections do not cause severe and continued pain with swelling and ardor urinæ, they may be continued for one week, when, in favorable cases, the gonococci will have disappeared from the discharge. Following this a mild, astringent injection may be used.

The Irrigation Treatment.—This method is applicable to any stage of the inflammation. The apparatus required is an ordinary fountain syringe capable of holding one quart of the solution and having a suitable nozzle attached to the hose or a No. 10 soft rubber catheter. Potassium per-

Fig. 109.—Fountain syringe for irrigating the urethra.

Fig. 110.—Hard rubber syringe for treatment of urethritis.

manganate solution of the strength of 1:1000 is the one most frequently employed. A solution of bichloride of mercury of the strength of 1:20,000, with a drachm of sodium chloride to the quart: or protargol solution of the strength of 1:10,000 may also be used. The permanganate solution is used as hot as it can be borne. The method of its use is as follows: The syringe is filled and elevated two or three feet, the patient urinates and cleanses the glans. The catheter, if one is employed, is then carried down the urethra to the compressor urethral muscle, when the solution is allowed to flow until the anterior urethra becomes filled, when the catheter is withdrawn and the solution allowed to flow off. The injections are then repeated until the bag is empty. If the catheter is not used the nozzle of the hose is inserted into the meatus and this closed by lateral pressure and the solution carried on until the urethra is filled, when the nozzle is withdrawn and the solution allowed to flow off. During the acute stage, these injections are repeated

night and morning, and after this, once a day or every second day. When the posterior urethra is also involved the bag is elevated to the height of from four to six feet and the flow of the solution continued until the compressor urethræ gives way and the bladder is filled, then the catheter or nozzle is withdrawn and the fluid allowed to flow off. The process is continued until the quart of solution is exhausted. The strength of the solutions are gradually increased during the first week, or up to the limit of tolerance.

The greatest care should be exercised to keep the parts as clean as possible. The glans and foreskin should be frequently washed with a carbolized solution, and after each washing, and at the times of urinating, a clean pledget of cotton should be placed within the foreskin against the glans for the purpose of absorbing the discharge. In cases in which the foreskin is too short, a six-inch square of gauze of several thicknesses with a slit in the center can be slipped over the glans and then folded back over the end of the organ. The patient should be instructed regarding the contagious nature of the discharge, and the possibility of conveying it by the fingers to the eyes. The hands should be carefully washed after each dressing or handling of the organ. When the acute stage has passed, as indicated by the disappearance of the swelling and the absence of pain and frequent urination, injections may be ordered. These are given with a hard rubber syringe having a blunt nozzle and holding from three to four drachms of fluid. The nozzle of the syringe should be cleansed after using by immersing it in boiling water or in a strong antiseptic solution. If the latter, it should be washed off from the end of the syringe before it is used.

The following injections are to be recommended after the acute stage has passed:

℞

Protargol,	gr. 5
Aqua destil.,	℥ 5

This solution may be injected two or three times a day and its strength graually increased if pain is not caused.

℞

Potash permanganatis,	gr. 1
Aqua destil.,	℥ 6

M. et Sig.—Use as injection.

℞

Hydrarg. chlor. corros.,	gr. ½
Acidi carbolici,	gr. 12
Zinci sulphocarbolatis,	gr. 12
Boroglyceride (25 per cent.),	℥ 2
Aqua destil. q. s. ad,	℥ 6

M. et Sig.—Inject after urinating.

The strength of these injections may be increased or diminished according to indications. If they are causing severe pain, their strength should be diminished or the injections suspended. When the discharge continues beyond a reasonable time and an astringent action is desired, the following solutions are to be recommended:

℞

Ext. hydrast. fl. (colorless),	ʒ 6
Bismuthi subcarb.,	ʒ 6
Boroglycerid. (25 per cent.),	ʒ 6
Aqua destil., q. s.,	℥ 6

M. et Sig.—Inject after urination.

Or the following may be used:

℞

Zinci sulphatis,	gr. 10
Plumbi acetatis,	gr. 12
Tinct. opii.	
Tint. catechu, āā.,	ʒ 1
Aqua destil. ad,	℥ 6

M. et Sig.—Inject after urinating.

Ultzmann's prescription is much used and is as follows:

℞

Zinci sulphatis.	
Pulv. alum.,	āā gr. 12
Acidi carbolici,	gr. 4
Aqua. destil.,	℥ 4

M. et Sig.—Inject after urinating.

Treatment of Acute Posterior Urethritis.—When tenesmus, frequent urination, and pain in the perineum indicate that the posterior urethra is acutely involved, all active treatment of the anterior urethra should be withheld. The patient should obtain as much rest as possible, the bowels should be kept open and the urine rendered bland and non-irritating by the use of salol, urotropin, or acetate of potash. Hot baths are very serviceable in these cases, while suppositories of belladonna, hyoscyamus, or opium may be inserted into the rectum. In some cases mild antiseptic flushings of the posterior urethra and bladder are serviceable. The abortive treatment should be carried out with great care, especially by the inexperiencd, and if the symptoms are aggravated, it should be suspended.

Internal Medication and Constitutional Treatment.—It is very important that the patient avoid active exercise as much as possible, especially during the acute stage. Food should be simple and non-irritating, while sexual excitement, alcohol, strong tea and coffee, and meat should be avoided and the patient encouraged to drink freely of milk and water. Bromide and acetate of potash are very serviceable during the acute stage

for the purpose of rendering the urine bland. After the first few days sa or urotropin in five grain doses, four or five times a day, may be substituted, or oil of sandalwood, in five drop doses, may be given.

CHRONIC ANTERIOR URETHRITIS.

A purulent discharge continuing for more than ten weeks is an indication of chronic gonorrhea or gleet.

ETIOLOGY.—The persistence of the discharge may be due to the use too strong injections, thus continuing the irritation. It may be the result excesses in eating or drinking, to sexual excitement or to over-exerci Such constitutional conditions as oxaluria, phosphaturia, rheumatism a gout may be responsible for the continuance of the discharge.

PATHOLOGY.—The condition is usually due to the presence of gonoco in the ducts, follicles, and deep epithelial layers of the mucous membra The process is manifested by round-cell infiltration of the epithelial and su epithelial tissues, by the occurrence of cellular proliferations, the formati of new tissue and the occurrence of stricture.

SYMPTOMS.—Usually the most pronounced symptom is the drop muco-purulent discharge which appears at the meatus in the morning. times the discharge may be quite free or there may be but a slight moistu at the meatus, or the lips may be glued together in the morning and befo urinating. Again there may be no discharge at all, only a few threads flo ing in the urine. The stream is usually forked or twisted and there is dribbling of urine after urinating.

DIAGNOSIS.—The diagnosis is made by the appearance of the dischar which is muco-purulent. The urine being passed in two portions, the seco portion is clear. Palpation of the urethra will usually show areas of tende ness or thickness. If thought necessary, a microscopical examination of t pus-threads will establish the presence or absence of gonococci.

PROGNOSIS.—The curability of chronic gonorrhea is in direct propo tion to its duration. The longer the inflammation has continued, the mo difficult the cure. This is in consequence of the process becoming de seated, where the inflammatory exudate may become organized and ca a stricture of the canal. Stricture is the most frequent complication chronic anterior urethritis of gonococcic origin.

TREATMENT OF CHRONIC ANTERIOR URETHRITIS.—The first consider tion is the restoration of the urethra to its normal caliber. This is acco plished by passing sounds of gradually increasing size. Before the use the sounds the patient should empty his bladder and the glans should cleansed with carbolized water or other antiseptic. The sound should sterilized in boiling water, then the largest sound that will pass the strictu is dipped into olive oil or smeared with sterilized vaseline and gently, almo by its own weight, allowed to enter the bladder. The sound is left in th position for from three to five minutes, when it is withdrawn and the car flushed with a solution of protargol, 1:2,000, or other antiseptic solutio The treatment is to be repeated in two or three days, when, if necessary, sound a size larger may be passed. The size of the sounds is gradua creased until the canal is dilated to its full extent. Aside from dilating t al the sounds have a favorable effect upon the inflammation in that th

The strength [illegible] absorption of the inflammatory ing to indications. [illegible] to contract. The use of diminished or the i[illegible] frequently effect a cure in chronic yond a reasonable [illegible] solutions are to be r[illegible]

[illegible] PRINTHEATIS.

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Ext. hydra[illegible] of the sub-epithelial connective
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Boroglycer[illegible] the ejaculatory and prostatic
Aqua destil[illegible]
M. et Sig.– [illegible] with ardor urinæ, is one of [illegible] present, and it may be more or [illegible] in the rectum or radiates [illegible] be found in the urine [illegible] During an acute attack, [illegible] meatus.

Or the following m[illegible]

℞

Zinci sulphati[illegible] such symptoms as gonorrheal
Plumbi acetati[illegible] frequent exacerbations after ap-
Tinct. opii.[illegible] epididymitis, prostatitis, and
Tint. catechu, [illegible]
Aqua destil. ad.[illegible] good. A great many patients
M. et Sig. Inj[illegible] cases the inflammatory process [illegible] indefinitely and does irreparable [illegible] structures, and seems to be a factor [illegible] processes.

[illegible] mann's prescription

℞

[illegible] to the diet, hygiene, internal [illegible] should be bland and non-stimu-
[illegible] considered. Oil of sandalwood,
[illegible] administered so long as the stomach is

[illegible] urethra should be massaged through [illegible] the purpose of emptying the cysts [illegible] catheter is carried down until its end [illegible] muscle, when a solution of argyrol, [illegible] permanganate, 1:10,000, is in-
[illegible] this injection a fountain syringe [illegible] solution is attached to a catheter, [illegible] urethræ and the fluid turned on, [illegible] fluid runs out of the meatus. [illegible] washed out. These treat-
[illegible] ks, or until the gonorrhœal [illegible] following this the treatments

[illegible] ical irritation and an in-
[illegible] weakened or its use sus-
[illegible] may be gradually in-
[illegible] treatment, the symptoms
[illegible] frequency to urinating,

[illegible] Acute Poster[illegible]
[illegible] and pain in the peri[illegible]
[illegible] involved all active treatm[illegible]
[illegible] patient should obtain [illegible]
[illegible] and the urine ren[illegible]
[illegible] or acetate of p[illegible]
[illegible] while suppositories o[illegible]
[illegible] into the rectum. In som[illegible]
[illegible] and bladder are ser[illegible]
[illegible] with great care, espe[illegible]
[illegible] gravated, it should be
[illegible] Medication and Constitu[illegible]
[illegible] patient avoid active exer[illegible]
[illegible] stage. Food should [illegible]
[illegible] alcohol, strong tea a[illegible]
[illegible] encouraged to drin[illegible]
[illegible] of potash are very servic[illegible]

The instillations are given through an instrument called an instillator, which is a silver or hard-rubber instrument, seven inches in length and shaped like a catheter and so fitted that a small syringe can be attached to its extremity. The solutions employed in the instillator are those of

and syringe for the treatment of chronic posterior urethritis.

argol, sulphate of copper and iodine, and carbolic acid. the solution is in inverse proportion to the amount nence with ten drops of a one per cent. solution at the increase the strength if the instillations are well borne.

Iodine and carbolic acid in equal parts, of the strength of 1 to 10 per cent, is used. Before the instillation it is best if the patient empty the bladder but partially, as a small portion of urine should remain to neutralize the excess of the instilled solution. In using the instillator it is first sterilized and then anointed, when from ten to twenty drops of the solution are drawn up into the tube of the instrument. The instillator is then carried down the urethra until its point engages in the compressor urethræ muscle, which is usually about the full length of the instrument, and then the fluid is gradually forced out by the syringe. These instillations should be repeated every two or three days and their strength gradually increased, provided they do not cause undue irritation. The instillations may be preceded by the passage of a full sized sound and by irrigation of the anterior urethra. Occasionally, the sounds are very irritating to the inflamed posterior urethra, if so their use should be discontinued. These instruments are especially serviceable in cases in which there is a slight discharge from the posterior urethra, frequent urination, emission, and constant or intermittent pain. They are contra-indicated when the discharge is profuse or the symptoms acute.

In inveterate cases Finger recommends medicated ointments. An ointment is smeared upon a warm, sterilized sound and this left to hang in the air until the ointment has cooled. The sound is then passed into the urethra, where the warmth of the parts melts the ointment which becomes applied to the inflamed tissues.

GONORRHEA IN WOMEN.

Frequency.—It is stated by Sanger that of 1,930 women coming to his clinic, 12 per cent. had gonorrhea. A considerable number of respectable women suffer from gonorrhea, while many young women contract the disease at the time of their marriage, as the result of a long standing and unheeded gleet in the male.

Seat of Infection.—The urethra is most frequently involved, while next in order of frequency comes the mucous membrane of the cervix, then the mucous membrane of the uterus, and, following this, infection of the Fallopian tubes. It is now generally held that the vagina is seldom involved except in children.

Contagion.—The disease, in the great majority of cases, is the result of sexual intercourse, although the probability of mediate contagion through the use of soiled towels and garments is much greater in women than in men. In girl babies mediate contagion may occur from an ophthalmia, from the genital tract of the mother, or from infected clothes.

An acute gonorrhea is usually acquired from an acute case, while a chronic discharge usually gives rise to the sub-acute or chronic inflammation.

Symptoms.—The symptoms of acute gonorrhea in women are not so pronounced as they are in men, and consequently some of the acute, and many more of the subacute, cases go unrecognized. In an acute case there is a discharge with heat, burning, and itching about the vulva, pain and undue frequency in urinating. The discharge may be slight, scarcely noticeable or very pronounced. If the uterine mucous membrane becomes involved there will be heat, pain and heaviness in the pelvis, while the dis-

charge is likely to be profuse. If the tube becomes involved, localized pelvic peritonitis with severe pelvic pain and a high temperature are usually present. An examination will disclose a swollen meatus with everted lips, usually a swollen and reddened vulva, congested cervix and often a hyperæmic condition of the vagina. Pus can be "milked" out of the urethra and may be seen flowing out of the cervical canal. The condition may not be detected because the symptoms are usually not pronounced.

DIAGNOSIS.—This will depend upon the symptoms, such as the urethral discharge, which is almost pathognomonic, the swelling and redness of the vulva and mucous membrane of the cervix, salpingitis, and localized pelvic peritonitis. If the uterine canal is not involved the latter symptom will be absent. For a positive diagnosis a microscopical examination should be made of a drop of pus "milked" from the urethra.

PROGNOSIS.—The prognosis of a gonorrhœal urethritis in women is much more favorable than it is in men, but the prognosis of the infection as a whole is very serious in women in consequence of the liability of uterine and tubal infection. Women with gonorrhœal infection of the uterus and Fallopian tubes seldom regain perfect health with their pelvic organs intact.

GENERAL TREATMENT.—The internal treatment consists in regulating the diet, keeping the bowels open, preferably with salines, and enforcing rest. Internally, during the first few days, sodium bi-carbonate or potassium acetate may be given for the purpose of rendering the urine bland and non-irritating. These remedies may be followed by salol, urotropin, oil of sandalwood, and the balsams.

A specific urethritis can usually be cured by internal medication, but if the process does not readily subside injections may be resorted to. The same formulæ may be used as in the male, but not more than a drachm should be injected at a time. In chronic cases, and especially in those in which there is some contraction of the canal, dilatation should be practised and a solution of silver nitrate applied.

BARTHOLINITIS.

This occurs in two forms, the acute and the chronic. An acute inflammation of the gland of Bartholine and its duct is of frequent occurrence during the acute stage of gonorrhea. The process is usually confined to one gland, although both glands may be implicated at the same time or in quick succession. Upon the posterior and internal surface of the major labium there appears a round, elastic, tense and painful swelling which often goes on to suppuration. The labium becomes so swollen and tender that walking is very painful. Pus, when formed, is usually discharged externally, but it may work its way into the perineum, or even enter the rectum producing a long, circuitous fistula.

TREATMENT.—Warm antiseptic fomentations are applied during the first few days, but as soon as fluctuation is manifest a free incision should be made. Following this the cavity is to be frequently irrigated and after the irrigation a pledget of absorbent cotton placed in the vulva.

CHRONIC BARTHOLINITIS.

If after incision and drainage of the suppurating gland the infection is not entirely gotten rid of, but remains as a chronic infection within the gland or its duct, exacerbations, acute suppuration, and abscess formation may subsequently occur. In these cases the gland can often be felt as a hard, sensitive nodule beneath the skin, and from the duct a few drops of pus may be squeezed out. In some cases the discharge is quite profuse.

TREATMENT.—The most satisfactory treatment for chronic cases is a free excision of the area which includes the gland and its duct. The wound can often be closed by deep sutures and primary union be attained.

GONORRHEAL VAGINITIS.

This may occur in children and in young girls. In adults the many layers of squamous epithelium are usually sufficient to prevent the penetration of the gonococci into the tissues.

SYMPTOMS.—There is a sense of weight and burning in the vagina attended by a profuse vaginal discharge. On inspection, the vaginal mucous membrane is reddened, œdematous, and often eroded. The process is usually associated with vulvitis, urethritis, and endometritis.

TREATMENT.—Rest should be enjoined and the vagina irrigated two or three times a day with a warm antiseptic solution. Following this a small [illegible] cotton partially saturated with glycerine and containing [illegible] is placed in the vagina. After the acute symptoms [illegible] an irrigation, the vaginal mucous membrane [illegible] day with tincture of iodine or a 10 per cent. [illegible]

ENDOMETRITIS.

[illegible] extends to the endometrium pro- [illegible] discharge. This can be seen [illegible] is attended with pain, swelling of the [illegible] desirable in this class of cases to confine [illegible] canal.

[illegible] be put to bed, the bowels kept open [illegible] but antiseptic vaginal douches [illegible] At least two or three quarts of [illegible] When the acute stage has passed [illegible] every two or three days with [illegible] of silver nitrate.

GONORRHEAL VULVO-VAGINITIS.

[illegible] infants infection may come [illegible] towels. In older [illegible]

[illegible] with a profuse and [illegible] vagina, and urethra. [illegible] painful.

[illegible] acute catarrhal [illegible] the latter is not in-

volved and the symptoms, both local and systemic, are much less severe. For a positive diagnosis a microscopical examination of the discharge should be made.

TREATMENT.—The child should be confined to the bed, the bowels kept open and the diet made bland and non-irritating. Three or four times each day a catheter is inserted into the depths of the vagina and the canal washed out with a warm antiseptic solution. Following this the vulva is dusted with a mild, antiseptic powder and separated by a pledget of absorbent cotton. The urine is kept bland by the administration of bi-carbonate of soda or salol.

COMPLICATIONS IN GONORRHEA.

Balanitis and balano-posthitis. By the term balanitis is meant an inflammation of the mucous membrane covering the glans penis, while by the term posthitis is understood an inflammation of the mucous membrane lining the foreskin.

BALANO-POSTHITIS.

This is an inflammation implicating both structures. Inflammation of these membranes is of frequent occurrence in persons suffering from gonorrhea, and who have, at the same time, a redundant foreskin and are uncleanly in their habits. As the result of an elongated foreskin, the discharge is retained within the pouch, where it irritates and often erodes the mucous surface.

In cases in which the discharge is especially virulent, deep-seated ulcers may occur in the glans penis, while the foreskin becomes markedly œdematous and in a state of inflammatory phimosis.

SYMPTOMS.—These will depend, in a measure, upon the severity of the case. In mild cases there may be only moderate heat, itching, redness, superficial erosions and a slight discharge with swelling of the foreskin. In severe cases all of these symptoms are exaggerated.

DIAGNOSIS.—If there is pain and urethral discharge, with acute symptoms preceding the balano-posthitis, the indications are very strong that the condition is due to gonorrheal infection.

TREATMENT.—The same general and internal treatment should be followed as in acute cases of gonorrhea.

LOCAL TREATMENT.—The foreskin should be retracted and the inflamed mucous membrane washed with a mild antiseptic solution two or three times every twenty-four hours. The parts are, after the washings, dusted with an antiseptic powder, a thin film of absorbent cotton placed over the glans and the foreskin brought forward. If the foreskin cannot be retracted in consequence of the œdema, an effort should be made to thoroughly wash out the sac through a small soft catheter. In cases where the œdema is marked and the swelling great, benefit is often derived by the continuous application of pieces of gauze wrung out of cold water. If it is difficult or impossible to satisfactorily cleanse the sac of the foreskin, and this is much thickened and indurated, and the phimosis marked, it should be slit open or a circumcision made.

LACUNAR ABSCESS.

This is the result of pyogenic infection in one or more of the lacunæ. The inflammation is manifested by the occurrence of a hard, tense, painful swelling upon the floor of the urethra. The process is likely to go on to suppuration, the pus being discharged either into the urethra or externally. In the latter case a penile fistula is apt to result. In the treatment the abscess should be opened as soon as possible in order to prevent the formation of a fistula. If a fistula has formed, it may be stimulated by light applications of the electro-cautery, or by silver nitrate in stick. If the opening occurs near the meatus, the urethra may be laid open down to the tract. In obstinate cases the edges of the fistula should be asepticized and then brought together by fine silk-worm-gut sutures.

INFECTION OF COWPER'S GLANDS.

This condition occasionally arises during a gonorrheal urethritis. It may go on to suppuration. Pus may be confined deep within the perineum, with symptoms very similar to those of an acute prostatitis, that is, pain deeply situated in the perineum, painful and frequent urination with rectal tenesmus. If suppuration occurs and the parts become infiltrated, the pus may make circuitous routes and lead to the formation of extensive fistulæ.

TREATMENT.—This should consist of an incision through the perineum into the suppurating focus when one exists. During the incision the urethra is to be protected with a sound and the rectum by the finger.

ACUTE EPIDIDYMITIS.

This is usually the result of an extension of the gonorrheal infection from the deep urethra. The process may follow the passage of a sound if proper antiseptic precautions are not used. The inflammation is made manifest by severe pain in the inguinal or hypogastric region. This soon extends to the epididymis. The pain in the epididymis is often excruciating. The epididymis becomes swollen, very tense, and can be felt as a large, elongated elastic crescentic mass covering in the testicle below, behind, and above. The cord becomes infected and is usually very sensitive.

Constitutionally there are high fever, marked prostration, loss of appetite, and an inability to sleep. Suppuration may, but rarely does, occur. Atrophy of the organ is much more frequent and is due to the organization and contraction of the plastic exudate. This exudate hinders the circulation through the spermatic vessels and interferes with the nutrition of the organ.

TREATMENT.—With the appearance of the first symptoms the patient should be put to bed and the bowels kept thoroughly open, while the diet is restricted and non-stimulating, and the urine rendered bland and non-irritating by drinking freely of water and milk and the administration of salol and acetate of potash. The testicle should be supported by a handkerchief and kept covered with compresses of gauze or absorbent cotton wet in a solution of lead and laudanum. When the pain is very acute the testicle may be smeared two or three times a day with the following:

℞

Guaiacol,	ʒ 2
Ext. belladonnae,	grs. 10
Vaseline,	ʒ 6

This application will often relieve the severest pain.

If the pain is excessive morphine may be given. In case of moderate severity, and even in severe cases, the pain is often promptly relieved by the application of a suspensory bandage (Fig. 112). This holds the testicles up against the soft tissues below the pubis, compresses them and relieves the congestion and pain. In the application of the compressory the testicles are held up for three or four minutes to relieve the congestion and are then covered with a thick layer of absorbent cotton and the supporter snugly applied. After the acute symptoms have subsided the patient may be allowed to get up but should still wear his supporter, while once a day for the purpose of relieving induration and chronic inflammation an ointment consisting of ichthyol 1 drachm and vaselin 7 drachms, may be applied.

Fig. 112.—Suspensory bandage for the scrotum and testicles.

PROSTATITIS.

Inflammation of the prostate gland occasionally occurs as the result of gonorrheal infection of the posterior urethra. The inflammation usually occurs not earlier than the third week of the attack and affects the glandular structures of the organ.

Symptoms and Course.—There is pain, frequency and difficulty in urinating, with fullness, distress, and tenderness in the rectum. The pain is situated in the deep urethra and is much aggravated by the passage of urine and feces. In the majority of cases the inflammation subsides under rest and proper treatment. In a few the process goes on to suppuration in which case all of the symptoms are aggravated. Constitutional disturbance is usually marked. There is high fever, occasional chills, and all of the symptoms pointing to a septic inflammation. On rectal examination the gland is found swollen and at some one place exquisitely tender. The abscess often breaks into the urethra, manifested by an increase of the pain with a discharge of blood and pus with the urine. A cure usually takes

place in a short time in cases in which the abscess is well drained. In other cases the pus discharges into the rectum, or it may break through the capsule of the gland and reach the perineum.

TREATMENT.—In the treatment the patient should be put to bed, have his bowels open and be put upon a bland, non-irritating and non-stimulating diet. Hot sitz-baths and hot rectal injections are very soothing. Rectal suppositories containing opium and belladonna are often necessary. If the patient is not able to pass his urine, a soft catheter may be inserted into the bladder and left there during the acute stage. If an abscess breaks into the urethra and shows no tendency to heal, it should be washed out twice daily by the following method: The abscess is first emptied by "milking" the prostate with the finger in the rectum. The bladder and urethra are then washed out with an antiseptic solution and the milking and washing repeated. If an abscess of any considerable size forms in the prostate, or if one breaks into the urethra and under proper treatment shows no disposition to heal, it should be opened and drained through the perineum. As an essential part of the treatment the urine should be kept aseptic and bland by the administration of salol and urotropin, and by directing the patient to drink considerable quantities of water and milk.

VESICULITIS OF GONORRHEAL ORIGIN.

This is a complication of gonorrheal infection of the posterior urethra which probably occurs much oftener than it is detected. The symptoms correspond closely to those of prostatitis and are represented by frequent, painful, and difficult urination. There is pain in the deep perineum and rectum and pain in the hip-joint. The latter is spoken of as being especially characteristic. The pain is increased by urination and defecation. A rectal examination shows a hard, irregular, fluctuating cord running upwards and outwards from the middle of the prostate. If both vesicles are affected the inflammatory exudate may extend from one vesicle to the other, presenting a hard, irregular mass on the base of the bladder. Abscess formation seldom occurs.

DIAGNOSIS.—This will depend upon the symptoms and rectal examination.

TREATMENT.—The treatment of acute cases is practically the same as that of an acute prostatitis. It consists of rest in bed, elevation of the pelvis, hot Sitz-baths or hot rectal injections; keeping the bowels open; controlling the pain by the use of belladonna or opium suppositories and the use of urinary antiseptics by the mouth.

GONORRHEAL CYSTITIS, URETERITIS, PYELITIS AND NEPHRITIS.

The involvement of these structures is comparatively rare as the result of gonorrheal infection. The symptoms which are now known to be due to posterior urethritis were formerly held to be indicative of cystitis. The trigone of the bladder is usually involved in posterior urethritis, but the general mucous membrane of the bladder ordinarily remains free.

Ureteritis, pyelitis, and nephritis seldom occur unless there is pronounced cystitis or obstruction of the urethra.

GONORRHEA OF THE RECTUM.

This inflammatory process is more frequent in women than in men. The symptoms are those of an acute inflammation. There is a purulent and blood-stained discharge, tenesmus, and painful defecation, the mucous membrane is reddened and often eroded.

TREATMENT.—In the treatment, the rectum should be frequently irrigated with a warm antiseptic solution such as bi-chloride of mercury 20,000. After the acute stage has subsided, and after cleansing by irrig tion, the mucous membrane and the erosions may be brushed with a ten p cent solution of silver nitrate. Opium suppositories are often necessary t the relief of pain.

GONORRHEAL CONJUNCTIVITIS.

In specific inflammation of the mucous membrane of the eye the inf tion is usually carried to the part by the fingers. In infancy the infecti occurs during the passage of the child's head through the soft parts of t mother. The first symptoms are usually manifest within forty-eight hou after infection. They are primarily those of an ordinary conjunctivitis, t lids and conjunctiva, however, soon become enormously swollen. There intense congestion with chemosis of the bulbar conjunctiva; the dischar becomes profuse and is yellow or green.

In severe cases the entire eye-ball may become infected. The infecti generally reaches its height in ten days and then gradually declines.

DIAGNOSIS.—This may be made by the history, the symptoms, and microscopical examination of the discharge.

TREATMENT.—The patient should be isolated and the well eye protect by a proper shield. Small pieces of ice in a cloth or bag are applied the infected eye or pledgets of absorbent gauze may be kept upon ice a frequently changed to the eye. The discharge should be frequently remov by irrigating the conjunctival cul-de-sac with boric acid or bichloride mercury solution; the latter being of the strength of 1:10,000. When t discharge becomes profuse the lid should be everted without making pr sure upon the eye-ball and the surface brushed over with a 1 to 2 p cent. solution of silver nitrate. The excess of silver solution is neutraliz by the use of a salt solution of the strength of a drachm to six or eig ounces of water. If ulceration of the cornea occurs the pupil should dilated with atropin. In cases in which the corneal ulcer becomes pr nounced cold applications may be changed to warm fomentations.

GONORRHEAL ARTHRITIS.

Inflammation of one or more of the joints is not an infrequent co plication of gonorrheal infection. It is due to systemic poisoning by t micro-organisms or their ptomains. The inflammation seldom begins befo the third week of the gonorrheal infection. The knee, ankle, wrist, elbo and the joints of the fingers are most frequently involved. It is stated th gonorrheal arthritis occurs in two per cent. of all cases of gonorrhea. T inflammation is more frequent in women than in men. The symptoms a high fever, severe pain, decided swelling, and great tenderness ed joints. The condition is one of arthritis, all of the structu

of the joint being involved. The joint is fixed in that position which will accommodate the greatest amount of fluid. The acute symptoms usually last for two weeks when they gradually subside. In some cases the process goes on to suppuration of the joint structures. In the ordinary case the joint remains tender, somewhat swollen, painful, and more or less fixed for several weeks, or even months. In other cases the process is less acute and takes the characteristics of a chronic inflammation.

DIAGNOSIS.—The diagnosis as a rule is not difficult, although primarily it may be mistaken for acute rheumatic arthritis. The characteristic features of gonorrhea arthritis are that the inflammation is confined to a single joint or that not more than two, or at the most, three joints are implicated. When more than a single joint is affected they are usually the joints of the fingers or toes. The process does not yield and is not benefited by the administration of the salicylates. The patient will have had a urethral discharge.

TREATMENT.—Confinement to bed and immobilization of the joint are indicated. Extension in some cases is beneficial. Opium may be required for the relief of pain. The diet should be non-stimulating and urotropin or salol with oil of sandalwood should be given internally for their antiseptic effect upon the urine and upon the urethral mucous membrane. If the exudate in the joint is excessive it may be aspirated, or the joint opened by incision and drainage for a few days established. After the acute symptoms have subsided and while the structures about the joint are infiltrated and the joint more or less stiff, counter-irritation with moderate massage and passive exercise may be used. An ointment containing 10 to 20 per cent. ichthyol in vaseline is very serviceable. In many cases, great benefit is derived by the frequent application of small blisters about the joint.

TENOSYNOVITIS

The tendon sheaths are occasionally involved as the result of gonorrheal infection. They become painful, sensitive, swollen, and the site of an exudate. If this is plastic there will be crepitation on motion, if it is serous, there will be fluctuation. The pain is increased by motion and fever is usually present. The tendon sheaths most commonly affected are the extensors of the fingers and the tendons of the toes.

As the result of systemic poisoning the planter fascia or the periosteum over the os calcis may become so sensitive as to prevent the patient from walking. The spinal erector muscles are occasionally affected and the site of severe pain on contraction.

In the treatment of tenosynovitis rest of the part should be enjoined and hot fomentations applied, while the part is given support by a compress and well-fitting bandage. With the decline of the acute symptoms passive motion aided by stimulating friction may be resorted to.

PHLEBITIS.

This is but rarely a complication of gonorrheal infection. The internal saphenous, the common femoral, and the superficial veins of the abdomen are those most frequently involved. The veins are attacked late in the course of the gonorrhea. The inflamed veins are hard, swollen, and pain-

ful. There may be œdema of the limb and there usually is pronounced fever.

TREATMENT.—The treatment is rest, elevation of the part, the application of warm compresses or the enveloping of the limb in a sheet of absorbent cotton, and then giving it support by a snugly-fitting bandage.

In the constitutional treatment tonics may be given. An excellent pill is the following:

℞.

Quininæ	grs. 20
Ferri. carb.,	grs. 30
Nucis vomicæ ext.,	grs. 10
Acidi arsen,	grs. 1½
Ext. taraxaci,	grs. 30

M. et sig.—Divide into thirty pills; one to be taken after each meal.

In addition to the complications already spoken of pericarditis, endocarditis, pleuritis and meningitis may occur.

CHANCROID (SOFT CHANCRE).

This is a contagious venereal ulcer probably of specific origin.

CAUSES.—Ducray, Wallander and others have described a short, thick bacillus with round ends which they think is the causative factor of chancroid. It is claimed that chancroid is always produced through the discharge of a similar lesion, that the ulcer runs a typical course, and that infection with the ordinary pyogenic organisms will not produce a typical chancroid. On the other hand, many pathologists and bacteriologists have failed to find in the discharge of chancroid a specific micro-organism, and hold that the chancroidal ulcer is simply due to pyogenic inoculation influenced by its peculiar surroundings.

Chancroid is a local and not constitutional disease. Its form and appearance will depend largely upon the virulence of the infectious material and upon the area or tissue primarily invaded, whether it is a hair follicle, a considerable abrasion, or a linear wound.

LOCATION.—A chancroid may be situated upon any cutaneous or exposed mucous surface. In the male it is most frequently found upon the glans penis, in the corona glandis, at the border of the frænum or meatus, upon the mucous surfaces of the greater and lesser labia, near the margin of the meatus, and about the anus.

PATHOLOGY OF CHANCROID.—This does not differ from that of an ordinary ulcer. The surface is covered with pus and necrotic tissue. The base shows a round cell infiltration, with proliferation of connective tissue cells and dilatation of blood vessels.

APPEARANCE AND CHARACTERISTICS OF CHANCROID.—There is seemingly a period of incubation of from one to seven days between exposure and the appearance of the lesion. The ulcer may be single, but it is more often multiple. Any mucous or cutaneous surface which comes in contact with the primary sore is likely to become infected and be the site of a secondary lesion. The lesion during its first stage is represented by a pustule, this

ruptures leaving an ulcer. The ulcer progresses rapidly, has ragged, excavated and irregular borders and a soft base. The surface is covered with pus and necrotic tissue and the discharge is free.

It is claimed that a follicular ulcer, or one which comes from infection of a hair follicle, often has an indurated base. A chancroid often causes suppuration in one or more of the related inguinal glands.

DIAGNOSIS.—The chancroid is to be differentiated from a chancre, from herpes, from a follicular ulcer and from the lesions of balano-posthitis. The principal differences between a chancre and chancroids are that the latter have a soft base, are multiple, occur in succession, and are often followed by a chancroidal bubo.

Fig. 113. Chancroids or soft chancres on the prepuce.

Herpes, follicular ulcers, and the lesions of balano-posthitis are more superficial and readily give way to antiseptic treatment. It is true that in some cases the base of the chancroid becomes indurated, as in the follicular chancroid, and again that the chancre may lose its distinctive hardness as the result of mixed or pyogenic infection, consequently it is not possible, in a given case, to form a positive opinion as to the presence or absence of the specific virus of syphilis.

PROGNOSIS OF CHANCROID. Ordinarily a chancroidal ulcer, if kept clean and treated by mild antiseptic measures, will heal in from four to six weeks without complications.

TREATMENT.—*Preventive.* In case of exposure infection may often be prevented by washing the glans and folds of skin and mucous membrane with some mild antiseptic solution such as carbolic acid or bichloride, at the same time, if an abrasion exist, it should be cauterized with carbolic acid or nitrate of silver.

Dry Treatment of Chancroid.—In carrying out this line of treatment the ulcer and the surrounding parts should be carefully cleansed with some mild antiseptic, dried and then lightly dusted with calomel, aristol, acetanilid, or zinc oxide. These cleansings and dustings are repeated from four to six times every twenty-four hours. After the powder has been applied a thin strip of absorbent cotton is wound about the part. Dry dressings are indicated in lesions of moderate severity without pronounced inflammation or profuse discharge.

Wet Dressings.—These dressings should be mildly antiseptic, a solution of carbolic acid, six to eight drops to the ounce, bichloride 1:3,000, or black wash may be used. Strips of absorbent cotton or gauze are wet in one of these solutions and applied to the ulcer. The dressing should be frequently changed. Moist dressings are applied to cases in which the inflammation is pronounced, the swelling marked, and the discharge profuse.

Cauterization.—Chancroids which are seen early, as well as those which show a tendency to spread, should be cauterized. Pure carbolic acid may be used for this purpose. It is applied by winding a bit of cotton on the end of a tooth-pick, dipping it into the acid and brushing the surface of the ulcer.

COMPLICATIONS OF CHANCROID—PHIMOSIS.

If a patient has a long foreskin, with or without a contractured preputial opening, and acquires a chancroid upon the glans penis or upon the internal surface of the preputial sac, he is likely to suffer, in consequence of the inflammatory swelling and the œdema of the foreskin, from phimosis. In these cases there is a pronounced discharge, often great swelling, and severe pain.

DIAGNOSIS.—The process is to be differentiated principally from gonorrhœa. If there was an absence of urethral discharge and of pain on urination, at the time the swelling commenced, and if a slight induration can be felt in the foreskin, the probabilities are that the condition is one of chancroidal ulcer.

TREATMENT.—There should be an effort made to cleanse the preputial sac by frequent irrigations through a small, soft catheter. If this cannot be satisfactorily done and the inflammation does not readily subside, the foreskin should be slit up along its dorsal surface so as to freely expose the lesions. Then the incision and chancroid should be thoroughly cleansed, and following this in ordinary cases a circumcision is done.

PARAPHIMOSIS.

This condition occasionally occurs as the result of a chancroid being situated on the external surface of the foreskin. In these cases, after a thorough cleansing of the parts, the ulcer should be cauterized and reduction attempted by continued pressure on the glans while contraction is made

forwards upon the foreskin. If reduction is not readily accomplished, the strictured prepuce should be divided and the raw surfaces cauterized.

GANGRENE OR PHAGEDENA.

As the result of violent infection, uncleanliness and a state of lowered vitality, great swelling with interference of circulation and subsequent gangrene of a large portion of the foreskin may occur, or the destruction may occur in molecular form (phagedena). In some of these cases the scrotum and perineum are extensively invaded and nothing but the stump of the penis left.

The treatment in these cases is to relieve the circulation by free incision and cure the infection by vigorous curettage, and the cutting away with a knife or scissors of all highly infected tissue. The wound should then be cauterized and free drainage maintained.

At the same time it is necessary to give attention to the general condition of the patient, which is usually in a deplorable state.

BUBO AND LYMPHADENITIS.

This is an infective inflammation of the related lymphatic glands in the groin following the occurrence of chancroid upon the genitalia. The process usually goes on to suppuration. It is the most frequent complication of chancre and is said to occur in from five to thirty per cent. of the cases. In persons who are cleanly in their habits, and in cases in which the chancroid can be kept clean, this complication is not likely to occur. The process is usually unilateral and upon the side of the chancroid, although in cases in which the ulcer occurs near the frænum it may be bilateral.

SYMPTOMS.—There is at first pain in the groin, increased by motion. The pain is followed by swelling of one or more of the lymphatic glands situated above the saphenous opening and below Poupart's ligament. As the swelling progresses the pain is often excruciating and is increased by motion. The skin becomes adherent to the gland, infected, reddened and fluctuation makes it appearance. After a time the pus is discharged through an opening in the skin. The capsule of the gland may rupture and the pus find its way into the subcutaneous tissue and be discharged through the skin after making a circuitous fistulous tract.

TREATMENT.—The condition can usually be avoided by proper antiseptic treatment of the ulcer and the prevention of retained secretions within the preputial sac. If the glans becomes infected, it is advisable to put the patient to bed, open the bowels vigorously and apply an ice-bag to the inflamed region. If this is not helpful, an ointment consisting of ichthyol, 1 drachm, and vaseline, 6 drachms, with 10 grains of extract of belladonna, may be applied to the inflamed area, night and morning. The part is then covered with several thicknesses of gauze and a spica bandage applied. If after from twenty-four to thirty-six hours of this treatment there is no improvement, but on the contrary the condition becomes aggravated, the infected glands should be excised. An incision is made below Poupart's ligament and the glands shelled out, or if they are adherent, or there is periadenitis, they may be removed en masse. These glands lie between the superficial and deep fascia. The position of the femoral vessels beneath the deep fascia

should be remembered. In place of excision, antiseptic injections may be made directly into the enlarged glands for the purpose of arresting the infective process and establishing resolution. From ten to fifteen drops of a ten per cent. solution of carbolic acid are injected into each of the enlarged glands. If pus formation and fluctuation is manifest, a free incision should be made into the suppurating area. The cavity should be thoroughly curetted and then lightly packed with iodoform gauze. Before packing the cavity it is well to explore with the finger in order to ascertain if there are any imperfectly drained pockets; if any are found, the incision may be extended so as to expose them. The wound should be re-dressed and re-packed each day, or every second day, until healing is completed.

SYPHILIS.

Syphilis is a contagious, inoculable disease and one that is capable of being transmitted by heredity. In acquired syphilis the disease is characterized (1) by the appearance of a chancre; (2) by general lymphatic involvement and superficial lesions upon the skin and mucous membranes; (3) by chronic inflammation of the cellular and vascular tissues including the bones and periosteum.

At the present time there seems to be but little doubt but that syphilis is caused by a specific micro-organism, the spirocheta pallida, described by Schaudinn and Hoffmann in May, 1905 (Fig. 90).

Immunity to Syphilis.—The syphilitic virus cannot be inoculated upon persons suffering from acquired syphilis, nor on one who has inherited syphilis from the parents, one or both, nor on a mother who has borne a syphilitic child, even though she has shown none of the manifestations of syphilis. It is possible in the rarest of cases for rëinfection to occur in a case of acquired syphilis.

The Contagion of Syphilis.—The secretions from a chancre and from the secondary eruptions, as well as the blood of the patient during this period, are all capable of transmitting the disease.

Methods of Contagion.—Contagion may be either immediate or mediate. Immediate contagion is from one person to another and usually takes place during sexual intercourse. It may, however, occur through wounds upon the hands or abrasions upon the lips, or in consequence of unnatural practices.

Mediate contagion is not by direct contact, but by the use of infected spoons, cups, pipes, cigars, handkerchiefs, clothing, razors, surgical and dental instruments, and human vaccine lymph.

Types of Syphilis.—Syphilis may, in very exceptional cases, commence and end with a chancre and inguinal adenitis, there being no secondary or teritiary stage. In these cases, if such there are, it is presumed that the infection has been very mild and has been overcome by systemic resistance. Again the chancre may be followed by general adenitis and a secondary eruption, while no tertiary symptoms make their appearance. These are called benign cases of syphilis. In the so-called malignant syphilis, the chancre often shows destructive tendencies, in that it enlarges rapidly and is often the site of sloughing. In these cases there is likely to be marked fever and pronounced anæmia, while ulcers form within the mouth and

nose. During the secondary stage gummata and deep ulcers are likely to appear, with involvement of the bones, viscera, and nervous system.

PERIODS OF SYPHILIS.—

I.—*Period of primary incubation.* This is the time intervening between exposure and the appearance of the primary lesion or chancre. This is of about three weeks duration.

II.—*Period of secondary incubation.* This is the time which elapses between the appearance of the chancre and the development of secondary symptoms. This period has a duration of about six weeks.

III.—*Period of secondary symptoms.* The symptoms occurring during this time are fever, anæmia, syphilitic neuralgia and eruptions upon the skin and mucous membranes. It has a duration of from twelve to eighteen months.

IV.—*Intermediate period.* During this time the patient may be entirely free from the symptoms of syphilis, or may have slight, secondary symptoms followed by complete recovery or by the symptoms of tertiary syphilis. This period lasts from two to four years.

Fig. 114.—Hard chancre.

V.—*Period of tertiary symptoms.* During this time, gummata, ulcers, chronic inflammations of the periosteum and bone, infiltration of the viscera, and affections of the nervous system are likely to make their appearance. These lesions usually occur during the third and fourth year following the chancre.

It should be understood that these periods are not always definite and well defined, but that one often runs into the other, while the tertiary period is usually absent in properly treated cases.

THE PRIMARY LESION OR CHANCRE.—This is frequently represented by a small spot of erythema which in a few hours becomes converted into a papule. The papule gradually expands in circumference and depth while it loses its superficial epithelium and in a few days becomes surrounded by

Under ordinary conditions a chancre is an ulcer. It is cup-shaped with a smooth surface, sloping margins and has a grayish false membrane clinging to its center (Fig. 114).

Induration.—The most characteristic feature of the syphilitic chancre is its induration. This is manifest by the end of the first week and reaches its height at the end of the second week. The induration is due to a cellular infiltration of the connective tissue and of the walls of the blood vessels in the deeper layers of the skin. The induration may be superficial or deep depending upon the extent and location of the infiltration. In superficial indurations the chancre if picked up and pressed laterally between the thumb and finger, gives a sensation as though a piece of writing paper was within the tissues. When the induration is deeper the feeling is that of a piece of parchment, and when still deeper that of a piece of binder's board implanted within the tissues. The induration of the chancre not only varies greatly, but may even be destroyed by pyogenic or chancroidal infection. The induration is greatest in man when the chancre is situated in the corona glandis, upon the glans penis, and within the foreskin. The induration is less marked in women and especially so when situated upon the lesser labia or fourchette.

Location.—The chancre may be situated upon any portion of the body. Genital chancres are those located upon the genitalia, while extra-genital chancres are those situated upon other portions of the body. The extra-genital chancre is most often found upon the lips, mucous surfaces of the mouth, anus, nipple, and fingers. As a rule extra-genital chancres are acquired in an innocent way. The extra-genital chancre is often not characteristic in that at times the lesion is slight, scarcely attracting attention, and again as the result of pyogenic infection, the induration may be absent.

THE DIFFERENT VARITIES OF CHANCRE.—

A chancrous erosion. More than one-half of the cases take this form. At first there is a simple erosion as might be produced by the finger nail, later this takes on the characteristics of an ulcer, becomes oval, and has a raw surface, the center of which is covered by a grayish, false membrane. The ulcer is surrounded by a dusky, red areola and from its surface there is discharged a blood-stained serum. In this lesion the epidermis exfoliates, but the skin is not destroyed. The induration is like parchment and occurs at the end of the first week.

Second: *A chancrous ulcer.* This may be superficial or deep. The superficial ulcer invades, but does not destroy, the skin. It is covered by a thin membrane, has a sero-sanguinous discharge, and the induration presents itself as a small nodule. The deep ulcer has sloping sides, a moderate discharge, and a cartilaginous hardness.

Third: *The indurated papule.* In this lesion the skin is not broken. The papule consists of a hard, dusky, raised tubercle which is well defined and may be large or small.

The well known characteristics of the chancre may be so modified as to escape recognition. Pyogenic or chancroidal infection may rid the chancre of its hardness, or the chancre may lose its induration with the appearance of secondary symptoms.

DIAGNOSIS OF CHANCRE.—In the future this will probably depend upon the discovery of the specific germ. There are, however, certain characteristics which should be considered and which are almost pathognomonic of hard chancre.

Incubation.—An ulcer which occurs in from ten to thirty-five days after exposure is likely to be specific. If the lesion is represented by a slight erosion which deepens into an ulcer, the ulcer refusing to heal under ordinary treatment and becoming markedly indurated at its base, it is likely to be specific in character. If the nearest lymphatic glands steadily increase in size and hardness without pain or other symptoms of inflammation, the enlargement commencing about one week after the development of the chancre, the probability of the specific nature of the ulcer is very great.

A differential diagnosis will rest upon the period of incubation, position, induration and the painless and non-inflammatory enlargement of the lymphatic glands. There will be difficulty in differentiating a mixed chancre from a chancroid, because in the former the characteristic hardness may have been destroyed by the inflammatory process. If an ulcer that primarily is devoid of hardness develops induration in two or three weeks, and after another week painless enlargement of the lymphatic glands occurs, the probability of the specific nature of the sore is great.

A syphilitic chancre is single, or if multiple they all occur at the same time.

Extra-Genital Chancre.—These occur most frequently upon the lips, tongue, breasts of nursing women, in the anal region and upon the fingers of physicians and midwives. The diagnosis depends largely upon the bacteriological findings, the characteristic induration of the ulcer, the primary enlargement of the nearest lymphatic glands and the non-responsiveness to ordinary treatment.

PROGNOSIS OF CHANCRE.—The healing of a primary lesion is hastened very much by the administration of mercury. If this is commenced early the ulcer may heal within three, six, or eight weeks. The induration and the enlargement of the glands remains longer. If mercury is not given the induration may be present at the end of ten or twelve months.

SYPHILITIC LYMPHADENITIS OR BUBO.

When the chancre is situated upon the genitals the related inguinal glands become enlarged at the end of the first week. These glands are painless, freely movable, and attain the size of an almond. The enlargement is quite characteristic of primary syphilis.

SECONDARY OR CONSTITUTIONAL SYPHILIS.

The time elapsing between the occurrence of the chancre and the appearance of the secondary symptoms is about six weeks. This period in exceptional instances may be prolonged to six months or may be shortened to two weeks. During this period the syphilitic virus becomes disseminated through the blood and the tissues of the body, the former of which is now infectious.

The first constitutional symptoms of syphilis are changes in the constituents of the blood with a diminution in the hemoglobin and red blood

corpuscles, and an increase in the leukocytes. The anæmia may become very marked as the disease progresses. Following this there is an indolent enlargement of the superficial lymphatic glands of the body. It is probably true that all of the glandular structures are more or less implicated, but the enlargement of the post-cervical glands, which extend as a chain from the occiput along the posterior border of the trapezius, as well as the enlargement of the epitrochlear glands is considered almost pathognemonic. The enlargement of the glands mentioned is much more characteristic than is the enlargement of the anterior cervical, axillary, or submaxillary glands. This enlargement occurs at about the end of the sixth week after the appearance of the chancre. The glands are small, seldom larger than a hazel-nut, are hard, smooth, freely movable and painless. They never undergo suppuration unless mixed infection occurs. This general enlargement of the superficial lymphatic glands is not to be confounded with the enlargement of the inguinal glands, which occurs at the end of the first week following the appearance of the chancre.

SYPHILITIC FEVER.

Fever is likely to occur at about the time of the lymphatic enlargement and at the time of or just preceding the cutaneous eruption. The fever may reach 102 degrees Fahr., or even more. It is usually associated with headache, loss of appetite, and general depression. The fever may be entirely absent. It usually disappears after the occurrence of the eruption.

SYPHILITIC NEURALGIA.

This is usually coincident with the fever. Acute pain may be felt in the back of the neck, back and shoulders, while at times the patient complains of severe pain in the bones.

CUTANEOUS ERUPTIONS.

It is impossible in a work like this to enter exhaustively into a consideration of the cutaneous eruptions of syphilis. At the outset it should be borne in mind that the skin eruptions occurring during the secondary stage of syphilis are not distinctive, but that almost every form of eruption may be simulated. They are especially characterized by their polymorphism, that is, before one form of rash disappears another or different kind makes its appearance. They develop slowly, are painless and do not itch. They are rounded in form, symmetrical and tend to scale. They are superficial, of a copper color, and yield to mercurial treatment.

The roseola or macular syphilide is one of the earliest and most frequent of the skin eruptions. It usually makes its appearance at the end of the sixth week after the development of the chancre. The spots are due to a hyperæmic condition of the superficial layers of the skin. They are round, or oval, well defined, not elevated, and the size of a split pea or ten cent piece. At first they are of a light, rose red, the color disappearing on pressure, later they assume a reddish-brown or "raw-ham" color and become pigmented. The number and size of these spots varies greatly. The eruption is most abundant on the chest, abdomen, upper extremities, and neck, and is more marked on the flexor than on the extensor surfaces. The rash readily disappears under mercurial treatment.

PAPULAR SYPHILIDES.—These may occur in the early or late secondary stage. The papules are of two kinds, the acuminate and the flat. Each of these may be divided into a small and large papular eruption.

The small acuminate papular syphilide usually makes its appearance during the first six months following infection and becomes fully developed during the course of two weeks. The eruption is in the form of reddish circumscribed elevations of the size of a millet or hemp seed, which grow in patches or groups containing from ten to forty papules. If situated near a hair follicle the papule may be capped with a vesicle, pustule or scale. The color is at first light red, later a reddish-brown and then often copper-colored. The eruption usually appears first about the neck, forehead, and wrists, and often assumes the circinate form.

The Large Acuminate Papular Syphilide.—These papules are usually few in number and are associated with the small papules. The eruption occurs most frequently on the back, gluteal regions, calves of the legs, and extensor surface of the arms.

Small, Flat Papular Syphilide. These are small, round or oval, distinctly flattened papules. The lesions occur especially on the flexor surfaces of the arms and legs, on the face and on the anterior or posterior surface of the body. In color, the papules are a dark brown.

The Large Flat Papular Syphilide. These spots are round or oval and vary in size from that of a split pea to that of a ten cent piece, or even larger. The borders are sharply defined and the lesion elevated above the surface of the skin. The papules are firm and have a flat, somewhat shiny surface. In color they may be bright-red or copper-color. These lesions usually occur in the middle or late secondary stage. The papular eruption is free from pain and itching. It is widely distributed, being found upon the forehead, face, back of neck, shoulders, chest, abdomen, flexor surfaces, scrotal and anal regions. Dry papules may become moist as the result of contact of skin surfaces and as the result of warmth, profuse perspiration, or unusual delicacy of the skin. As the result of irritation they may become converted into condylomata, papillomata or warty growths.

Condylomata are especially frequent about the genitalia and are due to the coalesence of individual papules and the stimulation of irritating discharges. In women they are frequent about the labia and perineum.

MOIST PAPULES.—Moist papules give rise to a very disagreeable and fetid discharge which is highly contagious. This is especially true when the eruptions are situated about the genitalia.

PAPULO-SQUAMOUS SYPHILIDE.—Although all forms of papules may at some time in their course undergo desquamation, there is in this variety such a distinctive tendency to desquamate as to make it characteristic. The scales are usually found at the apex of the papule. They are of an ashy gray color and show little tendency to exfoliate. Beneath the scales a reddish brown papule is to be seen. In some cases scales are at the base of the papule giving it a frayed-out appearance. This lesion is often met with on the face, chin, among the eye-brows, along the naso-labial folds, and perhaps most frequently on the palms and soles. Late in the course of the eruption and as the result of coalesence not only circinate forms occur but also festoons and branching figures.

PALMAR AND PLANTAR SYPHILIDES.—In consequence of the thickness of the epidermis eruptions upon the palms and soles are not ordinarily markedly elevated but occur as thickened, discolored, irregular patches, the size of a split pea or even that of a nickle. The center of the patch is often copper-colored, while the edges are covered with dark, grayish scales.

PUSTULAR SYPHILIDE.—Pustules may occur as an early or late manifestation of syphilis. The lesions vary in size from that of a pin's head to that of a split pea. They are of various shapes, flat, hemispherical or irregular. They may develop from a papule or vesicle. The pus usually desiccates forming crusts, beneath which there are punched-out ulcers. The crusts may be thin or thick, reddish or greenish-black. The pustular syphilide usually occurs in weak, debilitated or cachectic individuals.

THE MUCOUS MEMBRANES.—The syphilitic affections of the mucous membranes correspond in a general way with those of the skin. The lesions may occur as erythematous or papular eruptions or in the form of gummata. The appearance of the eruptions is modified in consequence of the heat, moisture and irritation incident to the location. In the erythematous syphilide of the throat it becomes red, hyperæmic, œdematous, and often superficially ulcerated. The process most frequently implicates the pillars of the fauces, the soft palate and uvula.

PAPULAR SYPHILIDE.—The papular eruption may occur as an erosion, a whitish diphtheroid area, a vegetating papule, an ulceration or as a scaly patch. The moist mucous patch, the so-called diphtheroid papule, appears as a small or large, discrete or confluent papule covered with a gray white pseudo membrane. The mucous patch is but slightly elevated above the surrounding surface, but is sharply defined by a dusky-red hyperæmic zone. If the pseudo-membrane covering the patch is removed a bleeding surface is left. This form of mucous patch is found in the inside of the cheeks, lips and at the angles of the mouth. These eruptions make their appearance during the secondary stage.

TUBERCULAR SYPHILIDE.—This eruption appears as round or flat elevations upon the surface of the skin of the size of a pin's head or almond. They are caused by an infiltration of the entire thickness of the skin. The eruption may be quite general or localized, confluent or discrete. The infiltrate may be absorbed, remain stationary for a long time, or go on to ulceration. The eruption may occur during the early secondary stage, or not until late in the tertiary period.

LOCATION.—It is most frequent about the face, lips, nose, forehead and back of the legs. It runs a chronic course.

SYPHILITIC ALOPECIA.

As a rule, during the secondary stage, the hair becomes dry, loses its lustre and falls out. There may be a general thinning of the hair or it may come out so as to leave bald patches. The areas of baldness may be situated in the eye-brows, within the beard, or upon the scalp. The hair follicles are not destroyed and the hair grows again.

PAINS IN THE BONES.

Late in the secondary stage severe pains often occur in the bones and joints. These pains may be associated with thickening of the periosteum,

especially over the crest of the tibia. The pains are more severe at night and the part affected is very sensitive to the touch. The condition ordinarily readily disappears under proper treatment.

SYPHILITIC IRITIS.

It is claimed that fifty per cent. of all cases of iritis are of syphilitic origin. The inflammation may assume the plastic, or parenchymatous form. The process occurs usually in the secondary stage.

SYMPTOMS.—There is often severe supra-orbital neuralgia, which is worse at night, photophobia, injection of the ciliary vessels, diminished and irregular pupil, altered color of the iris from effusion and posterior synechia. In the parenchymatous form yellowish-red nodules occur at the ciliary or pupillary border of the iris. The exudates clear up readily under specific treatment.

TERTIARY SYPHILIS.

GUMMATA OF THE SKIN.—These lesions may be manifest during the first year following infection, but as a rule they do not occur until the tertiary period. The lesions begin as a cellular infiltration of the subcutaneous tissue which is followed by the formation of new connective tissue. The infiltrate is made up of round, epitheloid, and spindle cells. Occasionally giant cells are formed. As a result of this infiltration and celluiar proliferation a node or gumma is produced, which may vary in size from that of a cherry to that of a hen's egg. There may be but a single gumma or there may be many. A gumma is a painless, indolent granuloma which is poorly supplied with blood vessels and ordinarily breaks down into a gummy or mucilaginous mass.

A gumma, under specific treatment, may undergo absorption or partial organization. The gummata are frequently situated upon the forehead, arms, forearms, tibial and scrotal regions.

GUMMATA OF MUCOUS MEMBRANES.—During the tertiary stage, these granulomata occur with great frequency within and beneath the mucous membranes of the mouth and naso-pharynx. They are usually of small size and readily break down forming small, ill-conditioned ulcers. They are frequently situated upon the hard and soft palate and nasal septum and are seen as dusky-red, well circumscribed infiltrations of about the size of an ordinary split pea. As the result of their breaking down and subsequent ulceration, the hard or soft palate and the septum of the nose are frequently perforated.

GUMMATA OF THE TONGUE.—Gummata are occasionally situated in the mucous of submucous tissue of the tongue. They usually are of small size, not larger than a grape-seed or cherry, are of slow growth and cause little or no pain. They are usually situated upon the dorsum of the tongue and readily break down producing punched-out ulcers.

Gummata may also infiltrate the muscular structures of the tongue, where they produce painless tumors of considerable size. They are usually situated upon the dorsum and may reach the size of a lemon. They are in-

dolent growths, which finally break down producing a gummy or mucilaginous fluid.

Differentiation. An ulcer of the tongue due to the breaking down of a gumma must be differentiated from a tubercular and from an epitheliomatous ulcer. The gummatous ulcer has these characteristics: It has been preceded by syphilis and by a pretty well circumscribed node or nodes upon the dorsum of the tongue. Both the node and ulcer are usually indolent and painless. The ulcer is the site of a free discharge, has a hard base and undermined borders. It may occur at or before middle-life and is influenced by mercurial treatment. The epitheliomatous ulcer is ordinarily very painful. It is not preceded by induration. It occurs in people past middle-life. It is not influenced by mercurial treatment and is usually small and slowly or rapidly progressive. Tubercular ulcers occur, as a rule, in the aged, they are small, cup-shaped, not specially indurated but painful lesions. The patient may give a family history of tuberculosis, or he may himself be tubercular.

Advanced gummatous infiltrations of the mucous membranes invading the muco-periosteum or muco-perichrondrium are not infrequent. In these cases the blood supply is interfered with and large ulcers, which invade the bones and cartilages, are formed. They often produce marked deformity of the nose and face.

SYPHILIS OF PERIOSTEUM AND BONE.

These affections have been divided by Cornil into three classes. First, osteoperiostitis; second, rarifying osteoperiostitis; and third, gummatous osteomyelitis. The syphilitic affections of bones are very frequent, especially in the secondary and tertiary periods.

In osteoperiostitis the lesion implicates the periosteum and superficial layers of the bone. The periosteum is hyperæmic while areas of embryonal cells are formed between the periosteum and bone producing nodes. The superficial layers of bone are vesicular, while the Haversian canals are enlarged. The nodes may not be larger than a hazel-nut or as large as a hen's egg. They are usually smooth, somewhat elongated, well circumscribed, elastic, very sensitive to pressure, and the site of severe pain, which is worse at night. While this process may affect any of the bones of the skeleton, it most frequently implicates the tibia, clavicle, ulna, sternum, and cranial bones. The process ordinarily yields readily to proper treatment.

Rarifying Osteoperiostitis.—In this affection, granulation tissue is formed in the deeper layers of the periosteum, between the periosteum and bone, and in the superficial layers of the bone. As a result of the process the trabeculæ become in part absorbed, the Haversian canals widened and the bone rarified. Under specific treatment new bone is formed, replacing that which was absorbed. This process of bone formation may be continued beyond that which is requisite for repair, and result in a narrowing of the canals and an increased density of the bone, or a condition known as osteosclerosis.

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GUMMATA OF MUCOUS MEMBRANES.—During the tertiary stage, these granulomata occur with great frequency within and beneath the mucous membranes of the mouth and naso-pharynx. They are usually of small size and readily break down forming small, ill-conditioned ulcers. They are frequently situated upon the hard and soft palate and nasal septum and are seen as dusky-red, well circumscribed infiltrations of about the size of an ordinary split pea. As the result of their breaking down and subsequent ulceration, the hard or soft palate and the septum of the nose are frequently perforated.

GUMMATA OF THE TONGUE.—Gummata are occasionally situated in the mucous of submucous tissue of the tongue. They usually are of small size, not larger than a grape-seed or cherry, are of slow growth and cause little or no pain. They are usually situated upon the dorsum of the tongue and readily break down producing punched-out ulcers.

Gummata may also infiltrate the muscular structures of the tongue, where they produce painless tumors of considerable size. They are usually situated upon the dorsum and may reach the size of a lemon. They are in-

dolent growths, which finally break down producing a gummy or mucilaginous fluid.

Differentiation. An ulcer of the tongue due to the breaking down of a gumma must be differentiated from a tubercular and from an epitheliomatous ulcer. The gummatous ulcer has these characteristics: It has been preceded by syphilis and by a pretty well circumscribed node or nodes upon the dorsum of the tongue. Both the node and ulcer are usually indolent and painless. The ulcer is the site of a free discharge, has a hard base and undermined borders. It may occur at or before middle-life and is influenced by mercurial treatment. The epitheliomatous ulcer is ordinarily very painful. It is not preceded by induration. It occurs in people past middle-life. It is not influenced by mercurial treatment and is usually small and slowly or rapidly progressive. Tubercular ulcers occur, as a rule, in the aged, they are small, cup-shaped, not specially indurated but painful lesions. The patient may give a family history of tuberculosis, or he may himself be tubercular.

Advanced gummatous infiltrations of the mucous membranes invading the muco-periosteum or muco-perichrondrium are not infrequent. In these cases the blood supply is interfered with and large ulcers, which invade the bones and cartilages, are formed. They often produce marked deformity of the nose and face.

SYPHILIS OF PERIOSTEUM AND BONE.

These affections have been divided by Cornil into three classes. First, osteoperiostitis; second, rarifying osteoperiostitis; and third, gummatous osteomyelitis. The syphilitic affections of bones are very frequent, especially in the secondary and tertiary periods.

In osteoperiostitis the lesion implicates the periosteum and superficial layers of the bone. The periosteum is hyperæmic while areas of embryonal cells are formed between the periosteum and bone producing nodes. The superficial layers of bone are vesicular, while the Haversian canals are enlarged. The nodes may not be larger than a hazel-nut or as large as a hen's egg. They are usually smooth, somewhat elongated, well circumscribed, elastic, very sensitive to pressure, and the site of severe pain, which is worse at night. While this process may affect any of the bones of the skeleton, it most frequently implicates the tibia, clavicle, ulna, sternum, and cranial bones. The process ordinarily yields readily to proper treatment.

Rarifying Osteoperiostitis.—In this affection, granulation tissue is formed in the deeper layers of the periosteum, between the periosteum and bone, and in the superficial layers of the bone. As a result of the process the trabeculæ become in part absorbed, the Haversian canals widened and the bone rarified. Under specific treatment new bone is formed, replacing that which was absorbed. This process of bone formation may be continued beyond that which is requisite for repair, and result in a narrowing of the canals and an increased density of the bone, or a condition known as osteosclerosis.

GUMMATOUS OSTEOMYELITIS.—In this affection the new tissue is in the form of a node or nodes. The nodes may be situated beneath the periosteum, within the bone or in the medulla. They may be associated with a rarifying or productive osteoperiostitis. The gummata are usually surrounded by condensed, fibrous tissue. Gummatous osteomyelitis may implicate any of the bones of the skeleton, but occurs with special frequency in the bones of the skull. When affecting the cranial bones they are often situated within the diplöe, where they cause great destruction of bone.

The diagnosis will rest upon the history, location, and course of the disease, and upon the effect of therapeutic measures.

SYPHILITIC ARTHRALGIA.

Pain in the joints may occur early in the secondary stage. The large joints are most frequently implicated, especially the knees. The pain is often very severe and is worse at night. The joint is somewhat stiffened, but there is neither redness of the skin nor swelling of the affected joint. The process readily yields to treatment.

SYNOVITIS OF SYPHILITIC ORIGIN.

In this affection the synovial membrane may be practically of normal thickness, or if the process occurs in the late tertiary period it may become greatly thickened. In synovitis of the secondary stage, the effusion is slight, but the pain is severe and worse at night. In synovitis of the tertiary period, with marked thickening of the synovial membrane, the effusion is usually pronounced, the swelling great and the pain severe.

The diagnosis will rest upon the history, the absence of gonorrhœa or a trauma, the course and response to treatment.

MYOSITIS.

Syphilitic myositis may occur in one of three forms; the irritative, the diffuse interstitial and the gummatous myositis. In the irritative form the muscles are sensitive to pressure and the site of pain or contraction. The symptoms are very much like those of muscular rheumatism. In the diffuse interstitial form there is a round cell infiltration and the formation of connective tissue between the muscular fibres. If this is pronounced and followed by contraction, interference with the nutrition and function of the muscle and subsequent muscular atrophy will be the result.

GUMMATOUS MYOSITIS.—Here the gummata are usually situated within the muscles. They are well circumscribed, elastic, and somewhat painful. They have a decided tendency to break down and be discharged, leaving ill-conditioned ulcers. Their size varies from that of a small marble to that of an orange.

SYPHILITIC EPIDIDYMITIS.

This process commences, ordinarily, in the secondary stage and implicates the globus major. The lesion is indolent, non-inflammatory and usually in the form of a node or nodes. These are hard, well circumscribed and not painful or tender upon pressure. The node or nodes are seldom li

DIAGNOSIS.—The process is to be differentiated from tubercular epididymitis.

Syphilitic Epididymitis.	*Tubercular Epididymitis.*
History of the case will often show syphilis.	History of the case will often show tuberculosis.
Skin rarely affected.	Suppuration and ulceration frequent.
Pain insignificant.	Pain, heat and burning often severe.
Head of epididymis involved.	Tail of epididymis involved.
In early stage specific treatment relieves symptoms.	General treatment has no affect.

SYPHILITIC ORCHITIS.

This is one of the frequent complications of syphilis. It seems to be pre-disposed to by a previous gonorrhœal epididymitis. The process may assume the form of an interstitial inflammation with infiltration and subsequent organization and contraction of the tissues or gummata may be formed, or the two processes may be combined. The interstitial form usually occurs in the secondary stage of syphilis. It comes on insidiously; the testicle enlarges to two or three times its normal bulk. It is indurated, but usually free from pain and sensitiveness. The testicle is usually smooth, or it may be nodular. The enlargement is slowly progressive for weeks or months. After reaching a considerable size it may remain stationary for months and then gradually subside.

GUMMATOUS ORCHITIS.—This lesion often follows or accompanies the interstitial type. In place of the general enlargement, there are regular or irregular nodes to be felt within the testicle or upon its surface. As they increase in size the skin may become reddened and adherent. The node may soften in the center and discharge through the skin, leaving a punched-out ulcer with dusky, indurated borders. The ulcer is irregular and without healthy granulations.

DIAGNOSIS.—

Syphilis.	*Carcinoma.*	*Tuberculosis.*
History of the case will usually show syphilis.	History of the case may show an injury.	History of the case may show tuberculosis.
Age, from 25 to 35 years.	Usually after 50 years.	In young adult life.
Cord not implicated.	Cord and inguinal glands usually implicated.	Cord may be implicated.
Process chronic, does not especially affect the health.	Patient usually dies within one or two years.	Process chronic, general health implicated.
Pain slight, ulceration and suppuration rare.	Pain severe, ulceration frequent, suppuration absent.	Pain slight, ulceration and suppuration frequent.

Testicle seldom reaches twice its normal size.	May reach several times its normal size.	Seldom more than twice its normal size.
Condition often relieved by internal treatment.	Internal treatment of no effect.	Internal treatment has little or no effect.
Skin ordinarily not involved.	Skin adherent, ulcers and fungus growth common.	Skin often adherent and inflamed.
Veins over testicle normal.	Veins much enlarged.	Veins normal.
Affection is frequently bilateral.	Unilateral.	Often bilateral.

PROGNOSIS.—This is usually good. Cases that are seen early respond readily to mercurial treatment. Impotence seldom occurs, even if both glands are involved.

SYPHILITIC ARTERITIS.

This is generally a tertiary lesion. The process involves the small vessels and especially those of the brain. The lesion consists in a cellular infiltration of the walls of the vessels, with subsequent organization and contraction of the infiltrate. The lumen of the vessel is by this means narrowed, or perhaps occluded. If the vessel is a terminal one and its lumen blocked, there will be ischæmia of that portion of the brain supplied by this particular vessel, followed ordinarily by softening.

SYPHILIS OF THE NERVOUS SYSTEM.

THE FORMATION OF GUMMATA.—This is ordinarily a late tertiary manifestation of syphilis although it may occur in the secondary stage. In addition to the changes in the blood vessels, there is a cellular proliferation, and a cellular infiltration in the affected region. The areas implicated are often multiple, there being two or more gummata formed, and these may be situated upon or beneath the dura mater in the subarachnoid space at the base of the cerebral hemispheres, or near the frontal convolutions. Gummata occur much more frequently within the membranes and upon the surface of the brain, than in its interior.

The process usually takes a chronic course. In the non-gummatous form there are large or small areas of the dura or soft membranes which are thickened and indurated. The gummata may be the size of a millet seed or that of an egg. They are gray, round, and firm. In the non-gummatous form the process occurs in patches and often along the course of the blood vessels.

SYMPTOMS.—Pain in the head is one of the most frequent symptoms. This may be constant, deep-seated, often excruciating in character and is usually worse at night. There is usually more or less failure of memory and weakness of the other mental faculties. The pain may be localized or diffuse, depending upon the extent of the lesion.

Neuralgia is a frequent symptom and often implicates the fifth nerve and especially its supra-orbital branch. In addition to these symptoms, there is often a lessening of the appetite, gastro-intestinal disturbance,

malaise, vertigo, disturbance of vision, excitability, and occasional epileptiform attacks followed by disturbance of motion.

DIAGNOSIS.—It has been stated that when traumatic and cardiac affections of the brain have been excluded, the probabilities are that an affection, producing the above symptoms, would be syphilitic. The diagnosis will depend upon the history of the case, this showing syphilis, the headache which is worse at night, the age of the patient usually between 25 and 50, the mental disturbances, epileptiform attacks, paresis, hemiplegia, and the results of treatment.

PROGNOSIS.—In the great majority of cases the patients never completely recover.

(In the treatment of syphilitic affections of the brain, iodide of potash and mercury should be given in full doses.)

SYPHILIS OF THE CORD.

This is a frequent tertiary manifestation of syphilis. It seldom makes its appearance before the third or fourth year following the initial lesion and at times the symptoms are deferred for fifteen or twenty years. The process occurs as diffuse infiltration, followed by sclerosis, as circumscribed gummata and as an endarteritis. The gummata occur upon the surface and in the center of the cord.

SYMPTOMS.—There are no symptoms which are peculiar to syphilis of the cord. The process may be acute or chronic. In acute meningitis of syphilitic origin, there is severe pain radiating throughout the area of distribution of the nerves, taking origin from the seat of the affection. The intense pain is often followed by paralysis, bed sores, and death. In chronic syphilitic affections of the membranes and cord the first symptoms are those of disturbed function, such as weakness of the limbs, difficulty in urinating, sexual weakness, and paralysis. Sensation is more affected than motion.

DIAGNOSIS.—This will depend upon the history and course, the effects of treatment and the exclusion of other paralytic affections.

PROGNOSIS.—This is unfavorable. The process may be temporarily relieved or even arrested, but as a rule the lesions are progressive.

It should be understood that every tissue and organ of the body may be affected by acquired syphilis, but only such lesions as seem of greatest importance to the surgeon have been considered.

TREATMENT OF SYPHILIS.—*The abortive treatment.* Two methods have been practised looking to the prevention of syphilis after the occurrence of a chancre. One of these is the excision of the chancre and the other is its destruction by cauterization. Neither method has succeeded in preventing the subsequent occurrence of syphilis except in the rarest of cases. Fournier holds that excision succeeds once in five times. Some physicians also believe that excision lessens the subsequent severity of the symptoms. Excision should not be practised if it will cause deformity or interferes with the subsequent functions of the parts.

If excision or cauterization are undertaken for the purpose of aborting syphilis, they must be practised during the first few days following the appearance of the ulcer and before the related lymphatic vessels and glands have become infected. If the chancre is located upon either surface of the foreskin, circumcision should be done.

In women if the chancre is located upon accessible parts after thorough cleansing it may be picked up with toothed forceps and excised with a pair of shears curved on the flat. The remaining wound may be sutured or cauterized. If the excision is not thought advisable nor consented to, the ulcer may be thoroughly cauterized with nitrate of silver or carbolic acid. If excision or cauterization are not practised, or the case is not seen until the end of a week, the chancre should be treated by mild antiseptic measures. It should be carefully cleansed two or three times during the day and then dusted with calomel, aristol, or other antiseptic powder. Compresses of lint may be soaked in black wash, a solution of carbolized water, or bichloride and applied to the part. Under ordinary conditions the ulcer will heal in from three to six weeks.

Internal Treatment.—If the spirocheta pallida is the specific organism of syphilis, this germ in the future will be sought after for diagnostic purposes, as it is most desirable to commence the administration of mercury during the primary stage, as by this means the secondary symptoms can usually be prevented and the whole course of the disease modified. In the past it has been the rule to withhold mercurial treatment until the secondary symptoms have made their appearance, so that the diagnosis might be established without a doubt. In all cases the mercurial treatment should be commenced as soon as the diagnosis is certain. At the present time mercury may be given in the following conditions: First, when the chancre is typical. Second, when the lesion shows marked tendency to progress. Third, when the chancre is situated upon exposed surfaces such as the lips, face and fingers. Fourth, when the chancre appears in a pregnant woman.

During the treatment the general vigor of the patient should be maintained at the highest possible standard. In the internal treatment protiodide of mercury in pill form is usually given. The pills contain one-sixth to one-third of a grain and are administered three or four times a day. The amount is gradually increased until there are pains in the abdomen with watery stools, some slight soreness of the gums and a hypersecretion of saliva. This amount is continued, if possible, without producing salivation, until the secondary symptoms are modified and then the amount is diminshed one-half and continued for two years. If protiodide is not well borne by the gastro-intestinal canal, mercury with chalk in one grain doses may be substituted, or bichloride of mercury, one-sixteenth of a grain well diluted with water may be given.

If the mercurial preparations cause severe abdominal pain with watery stools, the mercury may be combined with a small amount of opium.

If the mercury cannot be taken by mouth it may be administered by inunction or given hypodermically. Many physicians interrupt the internal administration of mercury every six weeks and prescribe inunctions for two weeks. In these cases from twenty to fifty grains of mercurial ointment is rubbed into the skin each day for six days, when a bath is taken on the seventh day and the inunctions resumed on the eighth day. When the treatment is followed, in order to prevent undue irritation of the skin, six different areas should be selected for the inunctions.

The first and second days the inunctions may be rubbed on the inside of the thighs; the third and fourth days upon the abdomen and chest, and the fifth and sixth days upon the inside of the arms and forearms. The seventh day the patient takes a bath and upon the eighth day the inunctions are resumed in the same order. At the end of the second week the patient goes back to the medication by mouth.

During the administration of mercury the greatest care should be exercised in order to prevent salivation. The teeth should be brushed after each meal with some antiseptic powder and the mouth thoroughly rinsed with a solution of chloride of potash, boric acid, listerine, or some other antiseptic.

At the end of two years, if the symptoms of syphilis have not entirely subsided, the patient should be given the mixed treatment for six months, that is, mercury with iodide of potash, and then if there are no manifestations of the disease the treatment may be suspended.

In the treatment of late tertiary symptoms large doses of iodide of potash are requisite, often as much as a dram of potash is given in water before each meal for long intervals.

HEREDITARY SYPHILIS.

Contagiousness of Syphilis.—The discharge from a chancre and that from all secondary eruptions, as well as the blood during the secondary stage, are contagious. The normal secretions such as saliva, sweat, milk and semen are not contagious. After the secondary stage neither the discharge from the eruptions nor the blood are contagious. This period of immunity is generally reached at the end of the second year.

Syphilis may reach the child, first, by descent from the father; second, by descent from the mother; third, by descent from both parents; and fourth, by direct infection.

Descent from the Father.—This is the most frequent and at the same time the mildest form of heredity. About thirty-eight per cent. of the children show manifestations of syphilis.

Maternal Descent.—This is more harmful to the fœtus than is the paternal descent, because the ovum is not only infected but during intra-uterine life syphilis in the mother exercises its baneful influence upon the fœtus. The mother may also contract syphilis during pregnancy and infect the fœtus. The lesions in these cases are less severe than in the cases where infection occurred at the time of conception.

Mixed Heredity.—By this it is understood that both parents, at the time of conception, are suffering from syphilis. These represent the most severe cases, and when this condition exists the ovum is almost certain to become infected.

Conceptional Syphilis.—By this is understood, a condition in which the father infects the fœtus through the semen, the mother remaining, for the time being, free, but subsequently becoming infected through the placental circulation.

Direct Infection.—By this is meant infection of the child during delivery. This is really a condition of acquired rather than hereditary syphilis.

Syphilis and Marriage.—Syphilis is extremely likely to be imparted during the first year of the disease. If both parents are infected the chances

of transmission are very great. If only the mother is infected the probabilities are less, while if the father alone is infected the fœtus escapes in fifty per cent. of the cases.

The probabiilities of infection become rapidly less after the second year. After the fourth year transmission rarely occurs. It is justifiable for a man to marry after four years, if he has been properly treated. The duration in women is slightly in excess of this. If conception takes place during the early secondary stage, abortion is likely to occur before the sixth month, the fœtus showing evidences of syphilis such as bullæ or blebs upon the palms of the hands and soles of the feet, an emaciated form and wrinkled skin. If conception takes place during the late secondary period, abortion will occur later or a living child is born showing signs of syphilis. The child is likely to die during the first six months. If the mother is carefully treated during the whole period of pregnancy, even if conception occurs during the first year, the child may be born healthy. The probabilities of a healthy child being born are very good after the second year, and they amount almost to certainty after the fourth year.

THE MANIFESTATIONS OF HEREDITARY SYPHILIS.—There is no primary stage and consequently, no chancre. The local manifestations of the secondry and tertiary stages correspond in a measure with those of acquired syphilis. A syphilitic child, at birth, is wasted, wrinkled, pinched and feeble, has a weak, hoarse cry, a nasal catarrh and usually a bullous eruption on the surfaces of the skin. The skin is harsh, non-elastic, and often has a dirty, yellowish tinge. The eyebrows, eyelashes, hair and nails show imperfect development. The child seems to be in an advanced stage of marasmus and usually dies during the first six months. When the influences of heredity are less manifest the child may seem well at birth, but in a few weeks lesions of the skin, mucous membrane, and eyes develop. These may be followed by infiltrations of the bones and viscera. Following the first outbreak there is usually an intermediary period lasting a year perhaps, until the end of the second dentition, or until puberty, during which time there is an absence of the symptoms of syphilis. The tertiary period may manifest itself at the time of the second dentition, at puberty, at middle life, or not at all.

Affections of the Skin and Mucous Membrane.—They correspond in a general way with those of acquired syphilis. They are, however, ordinarily more severe. The skin eruptions usually take the form of erythema, papules, vesicles or pustules. Ulcers are also frequent.

The Bullous Syphilide.—This usually appears upon the soles of the feet and toes, and upon the palms of the hands and fingers, and consists of blebs filled with a clear or bloody fluid. They have a tendency to spread and become confluent. The skin in these cases is of a yellowish tinge, non-elastic and the child presents the appearance of senility. This form of eruption is present at birth or appears soon thereafter. The erythematous syphilide appears during the second or third week after birth as small, round, oval, or irregular spots having a dull, red color.

Papular Syphilide.—This eruption follows the erythematous form and is most frequent upon the buttocks, palms, soles, and face. The papules are found in groups and tend to coalesce. When situated upon moist sur-

faces they lose their surface epithelium and are the occasion of an offensive discharge.

Tubercular and Gummatous Syphilids.—They usually occur at puberty and appear upon the face, nose, anterior surface of the legs, soft and hard palate, post-pharyngeal wall, and mucous membranes of the nose. They are painless, copper-colored, slowly growing infiltrations which manifest a decided tendency to break down and ulcerate.

Interstitial Keratitis.—This is an inflammation of the cornea evidenced by diffuse or circumscribed areas of haziness. It is one of the frequent manifestations of hereditary syphilis. The process primarily affects one eye, the second usually becomes affected weeks or months afterward. The areas of haziness are primarily separate, but later become confluent so that the entire cornea may become opaque. Usually photophobia and slight ciliary injection are also present. After some weeks or months the opacity may disappear, although some haziness usually remains. The vision, however, is ordinarily good. In very severe cases, the retina may become inflamed, followed by glaucoma and shrinking of the eye. The process usually occurs between the eighth and fifteenth years.

Fig. 115.—Hutchinson's, or syphilitic, teeth.

Fig. 116.—Grooves in non-syphilitic teeth.

Iritis.—This is also a frequent lesion in hereditary syphilis. It often occurs during early infancy. The pupil is irregular, especially under atropin. The iris is streaked with lymph, is dull, swollen and discolored.

The Teeth.—In hereditary syphilis the teeth are often implicated. The deciduous teeth are frequently mal-formed, deficient in enamel and irregular. Dentition is often retarded.

Grooved Teeth.—This is in a measure a characteristic of hereditary syphilis. There is usually a single groove placed transversely around the crown, near the free edge. In some cases there are two or three of these grooves. They present the appearance of having been made with a file. The grooves become stained dark and are quite noticeable. The process usually affects the incisors.

Hutchinson's Teeth.—This lesion is represented by a semilunar notch in the upper central incisors. This crescentic notch is usually bevelled at the expense of the anterior edge of the tooth. The teeth are often peg-

shaped, diminishing in size from the gum to the free extremity. The enamel is often deficient and the teeth decay early (Figs. 115 and 116).

Bones.—The bones are frequently affected during hereditary syphilis. Fournier says that these lesions are most frequent between the fifth and nineteenth years of age, although no period is exempt. The bones of the face and nose, and the tibia of the long bones, are most frequently involved. Later in the disease the bones of the skull are frequently affected.

Affections of the Periosteum and Bones.—Periostitis, ostitis, osteomyelitis and gummatous infiltrations are the lesions most frequently met with in hereditary syphilis. A process which frequently occurs at the junction of the epiphysis and diaphysis of the long bones is known as osteochondritis. In this affection there is a widening of the area of calcification with a swelling of the cartilaginous plate, the latter being due to a proliferation of the cartilage cells. In severe cases there may be a growth of granulation tissue between the bone and zone of calcification, producing softening and epiphyseal separation. The process is manifest by a thickening of the bone at this point.

The shaft of the tibia is frequently affected in congenital syphilis by the occurrence upon the crest of periosteal and sub-periosteal swellings and nodes. There also may be deformity with curves and even elongation of the shaft. When rickets can be excluded these nodes and grooves are almost pathognomonic of syphilis.

The bones of the skull are occasionally involved in hereditary syphilis. The process is usually a circumscribed osteo-periostitis affecting the frontal, parietal, or occipital bones. Nodes or bosses are also found producing an asymmetrical condition of the head. When these bosses are situated upon the frontal bone they are called Parrot's nodes. As the result of osteo-periostitis the bones may become very much thickened and sclerosed. On the contrary they may become partially absorbed and very thin, causing the bone, under pressure by the fingers, to crackle like parchment, the condition being known as craniotabes.

Syphilitic Dactylitis.—This affection commonly occurs in infants and may involve the periosteum, peri-articular structures, or bones.

The process is characterized by a spindle-shaped swelling of the phalanges of the fingers. The infiltrate tends to break down, leaving ill-conditioned ulcers. The process is ordinarily painless, frequently multiple and symmetrical. It may lead to destruction of the bones and joints with marked deformity. The process is to be differentiated from tubercular dactylitis which pursues a more chronic course and is not influenced by specific treatment.

Hereditary syphilis may affect the brain, spinal cord, lungs, liver, spleen, pancreas, intestines, kidneys, and testicles.

Diagnosis of Inherited Syphilis.—The primary stage of chancre is wanting. There will have been syphilis in one or both of the parents. There is often a history of premature births, or of children surviving only a short time after birth. The fœtus or still-born child is emaciated, wrinkled, skin muddy and non-elastic, epidermis macerated, while blebs appear on the soles of the feet and palms of the hands. Children prematurely born or carried to term, whether well developed or emaciated, are likely to show

at birth or shortly after, the characteristic symptoms of hereditary syphilis. If the child is not stunted and senile at birth, it is likely in a few weeks or months to suffer from coryza, hoarseness, syphilides of the skin, inflammation of the cornea and iris, enlargement of the liver and spleen and inflammation at the epiphyseal junction of the long bones. Late hereditary syphilis is likely to show stunted growth, pasty complexion, dryness of the hair, brittleness and splitting of the nails, bosses on the forehead, flat, sunken bridge of the nose and partial destruction of the vomer and palate bones. There is also enlargement of the epiphysis of the long bones, Hutchinson's teeth, haziness or opacity of the cornea, and cicatrices about the lips and nose.

TREATMENT OF HEREDITARY SYPHILIS.—This is preferably carried out by mercurial inunctions. White and Martin recommend the following method: The child's abdomen is bathed with castile soap and water, then with a solution of boric acid, after which it is carefully dried. One-half dram of mercurial ointment diluted with three parts of vaseline is then spread upon the binder and the latter applied in the usual manner. After twenty-four hours the abdomen is again washed with soap and water and with a solution of boric acid and then dried, when one-half dram of mercurial ointment is rubbed into the skin and the same binder applied. These inunctions are repeated every day, the binder being changed for a fresh one every fourth day. If the skin becomes inflamed it should be bathed with witch-hazel and dusted with zinc stearate, while the inunctions are rubbed into some other part of the body, as the back, chest, sides, arms, and legs. If the inunctions are not well borne, mercury with chalk may be given in from one-twelfth to one-half grain doses with a little sugar three times a day. In conjunction with the inunctions or with the administration of mercury and chalk, potassium iodide may be given in suitable doses. The treatment should be continued until long after all manifestations of syphilis have disappeared. The mixed treatment may be continued until after puberty.

RHINOSCLEROMA.

This is a chronic, inflammatory, infectious process of the skin and mucous membranes of the nose.

ETIOLOGY.—The process is probably due to the bacillus of rhinoscleroma described by Von Frisch. The organism occurs in the form of a short, thick rod with round ends and is surrounded by a distinct capsule. This germ probably belongs to the same family as the bacillus pneumoniæ of Friedlander (Fig. 95).

The pathological process is characterized by a chronic inflammation in which small firm nodules are formed beneath the skin and mucous membranes of the nose. The process usually commences at the junction of the nose and the lip, upon the alæ nasi or at the border of the cheek. The lesion often extends along the mucous membrane of the nose to the posterior nares or subcutaneously into the lip or cheek. In consequence of the number and size of the nodules the nares may be partially or entirely occluded, while large protruding masses are formed beneath the skin deforming [illegible] The nodes are hard, irregular and almost never ulcerate. The

disease is most frequently seen in Russia, Austria, Germany and Central America.

PATHOLOGICAL HISTOLOGY.—The lesion consists in a dense, cellular infiltration of the corium and papillary layer of the skin and of the connective tissue stroma of the mucous membrane. There is pronounced proliferation of the connective tissue cells of the part which later becomes converted into connective or fibrous tissue. Between these strands of fibrous tissue a round cell infiltration occurs. Many of the cells are in a state of hyalin degeneration and many are vacuolated.

The bacilli of the disease are found within the nodes and frequently in the vacuolated cells. The nodes are also rich in lymphatics. The nodular tissue when incised is of a yellowish or grayish-red color.

DIAGNOSIS.—The only disease with which rhinoscleroma is likely to be confounded is rhinophyma. In the latter there is nodular hypertrophy of the skin, subcutaneous tissue, and sebaceous glands. The nodes or lobes are soft, pendulous, greasy and usually situated upon the tip of the nose. The mucous membrane is not implicated. The condition usually occurs in alcoholics. In rhinoscleroma the nodules are hard; the process implicates the mucous membrane and often affects women.

PROGNOSIS.—This disease never terminates in death.

TREATMENT.—The protuberant masses are shaved off with a sharp knife, after which the wound may be allowed to heal by granulation or skin-grafting may be practised. If the nostrils become occluded they may be re-opened by excising wedge-shaped pieces or by deep cauterization of the parts.

TUBERCULOSIS.

This is a specific, infectious, slightly contagious disease characterized by a subacute or chronic course, and the formation of circumscribed nodules known as tubercles. The tubercle is the characteristic lesion of the disease and is a translucent, gray, well-circumscribed nodule of the size of a millet seed. It owes its origin to and is formed around one or more of the bacilli of tuberculosis.

Nodules somewhat resembling tubercles may be caused not only by other micro-organisms, but by minute foreign particles which produce a localized irritation, such as small pieces of glass or knots of thread. These tubercles, however, have not the cellular characteristics of the specific nodes of tuberculosis. The bacilli of tuberculosis finding a lodgement in the tissues under favorable conditions multiply and, as a result of their presence and the poisonous product engendered by their growth, the connective tissue cells in the immediate vicinity are stimulated to take on active proliferation. At the same time there is chemotactic influence exerted upon the lymphocytes. These two classes of cells, the connective tissue or epitheloid cells, and the lymphocytes, surround the bacilli and form tubercles.

HISTOLOGY AND PATHOLOGY.—Histologically a tubercle may be described as made up of three zones. The central zone is the oldest and may contain a giant cell or consist of protoplasm in a state of necrosis. The middle zone is made up of epitheloid and giant cells. The epitheloid cells are oval, elongated and several times larger than the white blood corpuscles.

The giant cell has been held to be characteristic of tuberculosis, but it occurs in other diseases, although not frequently. Aside from its size, the giant cell is characterized by having many nuclei, sometimes one hundred or more placed about the periphery. The long axis of these nuclei is directed toward the center of the cell. It is thought that the reason for their being arranged at the periphery is that the protoplasm at the center of the cell is usually in a state of necrosis and the nuclei move toward the border, where the protoplasm is more capable of affording them nourishment. It is thought that the giant cell is either the result of an active process during which the cell reaches a very large size, while its nuclei divide in an unusual degree or it is the result of the coalescence of many epitheloid cells. The outer zone of the tubercle is made up largely of lymphyocytes. This arrangement is subject to many changes, as, for instance, the giant cell may be wanting or there may be several, while the epitheloid cells and lymphyocytes may intermingle in a single zone. The lymphyocytes come from the blood and lymph nodes, the epitheloid cells from the connective tissue, while the giant cells probably have the same origin as the epitheloid cells. The bacilli can usually be demonstrated in and around the giant cells. Tubercles may also have a delicate reticulum and primarily a blood vascular system.

Tubercles increase in size by eccentric growth and by the coalescence of many adjacent tubercles until they reach the size of a pin's head or hen's egg or form large masses of tissue. It is seldom that a tuberculous process remains long confined to the original seat of infection, on the contrary new tissues and new areas are constantly invaded. This result is accomplished in consequence of the micro-organism becoming disseminated, while in a given tubercle the center may caseate, and some of the bacilli die their progeny invade the periphery or newer portions of the node, where they multiply. From this portion they reach adjacent areas by means of lymph currents and lymphocytes, while they are carried to distant areas by the lymphatics. Wherever they find a favorable lodgement, whether in the adjacent area, in the lymphatic vessels or glands, or in distant organs they multiply and cause the formation of tubercles.

A single tubercle or a tuberculous mass may undergo any one of several changes. Ordinarily the bacilli continue to multiply, but if the patient is not susceptible and has a high degree of resistance, there may be an active proliferation of connective tissue cells around the infected area separating it and converting it into a fibrous node, or the fibrous tissue surrounding a node may hasten its absorption or conversion into a chalky mass by the deposit of calcareous material. Disintegration and pus formation often occur as the result of caseation and liquefaction, ended by the occurrence of a serous exudate into the tuberculous tissue. This process is hastened in consequence of the poor blood supply to this tissue.

Tuberculous Pus.—This is a white, milky fluid containing large quantities of cheesy material. It is to be differentiated from pyogenic pus which is yellow, not so fluid (having a consistency of cream) and is without cheesy material.

Tubercular Abscess.—This process is distinctive in that the abscess cavity is lined by an irregular wall of soft tissue made up of granulation tissue, in which are imbedded innumerable gray or yellowish tubercles

This lining wall of granulation tissue is but loosely attached to the fibrous wall proper, and can readily be scraped off by the finger or with a dull curette. The abscess increases in size as the result of a serous exudate from the walls of the blood vessels.

A tuberculous abscess produces but few symptoms, either constitutional or local. There will be induration and swelling and, if the abscess is superficial, fluctuation, but there is an absence of heat, redness and usually of pain, or the pain is insignificant. The abscess increases but slowly in size, and in consequence of this fact, the absence of pain, heat and redness, it is called a cold abscess. Such an abscess may undergo spontaneous cure in consequence of the contraction of its fibrous wall, the absorption of the liquid content and the encapsulation or the calcification of the caseous mass.

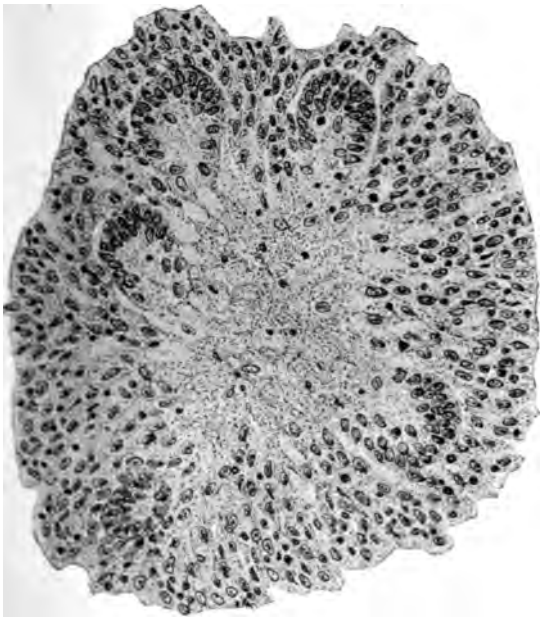


Fig. 117.—Giant cells in a tubercular process of the lung.

[illegible] abscess may open spontaneously, or be opened and heal- [illegible] consequence of the destruction of the living wall of granu- [illegible] contraction of the surrounding fibrous tissue and the [illegible] granulation and connective tissue. If after the opening [illegible] or its spontaneous rupture, pyogenic infection occurs, the [illegible] course are likely to become acute with severe pain, high [illegible] swelling, redness, and tenderness.

[illegible] There are various predisposing factors which favor the [illegible] tuberculosis. One of these is inherited weakness. Children [illegible] or syphilitic parents are likely to lack resistance and be [illegible] contagion of tuberculosis. Unhealthy surroundings, bad [illegible] anxiety, want of sleep, impure air, lack of sunshine and

poor or insufficient food are notable factors in the production of tuberculosis. In short, anything which debilitates or lessens the power of resistance of the individual will increase the susceptibility and favor the occurrence of tubercular infection. Tissues which are chronically inflamed have a lessened vitality and consequently are prone to tuberculosis.

Actual Cause of Tuberculosis.—This process is due to the tubercle discovered by Koch in 1882. These bacilli appear as short, slightly curved, slender rods (Fig. 88). These organisms when gaining an entrance into the system under favorable conditions multiply and produce the condition known as tuberculosis.

How Infection Occurs.—In the great majority of instances infection occurs through the mouth or nose, the infectious material entering the system either with the inspired air or with the food. The sputum of consumptives contains an innumerable number of bacilli. If this sputum is discharged upon the floor, in the street, in a handkerchief and allowed to dry, it readily becomes pulverized and is carried with drafts or currents of air in all directions and may be readily inspired. The consumptive also throws off these micro-organisms with every cough. Foods, when containing germs in a living state, such as milk and meat, fruits and vegetables, may, when taken into the stomach, cause tuberculosis of the intestinal canal. Infection may also occur through wounds. The anatomical tubercle which occurs upon the fingers of butchers and pathologists is an illustration.

DIAGNOSIS.—A positive diagnosis of tuberculosis can only be made by the detection of the bacillus of Koch. Miliary tubercles or tubercular masses in connection with the symptoms and course of the tubercular process are usually, however, sufficiently diagnostic. The microscopical arrangement of the cells is quite distinctive. In cases where the germs cannot be demonstrated, inoculation of the tuberculous material beneath the skin of the groin on a guinea pig may be practised. If the tissue is tubercular, and the guinea pig is killed in three weeks, it will show tubercular areas in the glands and in the internal organs.

PROGNOSIS.—In any tuberculous process there is great danger of diffusion. Such a process seldom remains long localized. The lymphatic vessels and glands are invaded by the micro-organisms and from these the infection is likely to become systemic or general.

TREATMENT.—*General.* No matter what the tuberculous process, nor in what tissue situated, in the bones, lungs or lymphatic glands, the patients should be put in the best possible physical condition. This can only be accomplished by keeping them in the fresh air and sunshine and in giving them plenty of nourishing and easily digested food, such as milk and raw eggs. In suitable cases tonics and anti-tubercular remedies should be administered.

In the surgical treatment of localized affections, the part is elevated and put at rest under compression. In superficial affections, especially of the skin, the X-ray treatment is very serviceable. In the treatment of abscesses rest should be enjoyed and attention given to the general condition of the patient. If the abscess is localized and near the surface, or when situated in a lymphatic gland, it may be excised or enucleated. If the

abscess is large and accessible, its contents may be drawn off and the cavity injected with a ten per cent. emulsion of iodoform in glycerine. If the abscess refills, as it often does, but perhaps more slowly, it may again be tapped and injected. Often during this treatment each refilling occurs more slowly than did the previous one, and in many cases three or four injections are sufficient to cure a large abscess. Ordinarily not more than six ounces of the emulsion should be used at a time. If the tapping and injections are of no benefit the abscess should be incised, washed out and the internal lining removed either with a dull curette or swab. Following this, from four to six ounces of iodoform emulsion is poured into the cavity and an iodoform wick inserted. In forty-eight hours the gauze should be removed, the cavity irrigated and a fresh piece of gauze inserted. Following this the dressings will have to be changed every twenty-four hours. The walls of the abscess can often be compressed and the cavity partially obliterated by compresses and a bandage.

In psoas abscesses Treves recommends incision, draining off of the pus and a careful removal of the lining membrane with gauze swabs followed by thorough irrigation. Then a quantity of iodoform emulsion is poured into the cavity and the incision closed without drainage.

CHAPTER VIII.

SURGERY OF THE GENITO-URINARY TRACT.

SURGICAL AFFECTIONS OF THE KIDNEY.

The kidneys are placed in the lumbar region on each side of the spine. They extend from the eleventh rib above to midway between the last rib and the crest of the ilium below. The right kidney, in consequence of the position of the liver, is placed slightly lower than the left. The hilum of the kidney is situated opposite the first lumbar vertebra and looks forwards and inwards.

In the normal condition the kidneys are not capable of being palpated, or, at best, not more than the lower poles upon deep inspiration. In an examination for possible pathological affections the patient should lie on his back with his head elevated by a pillow and the thighs drawn up to nearly a right angle. The entire abdomen is exposed, palpated and percussed. A kidney which is very much enlarged is not likely to remain in its normal situation, but to assume a position below the ribs. It may often be found as low as the iliac fossa.

In examining the kidney region with the patient on his back, the palm and fingers of one hand are pressed into the lumbar region, while with the other hand gentle but firm pressure is made against the abdominal wall just below the ribs. During a deep inspiration the kidney is forced downwards, and, if movable, its size and outline can be determined.

A kidney is a firm, elastic, flattened organ which readily slips away from the examining fingers. A kidney that is forced down below the costal arch by deep inspiration readily returns to its normal position unless quite large, or when restrained by combined pressure. The kidney is placed behind the peritoneum, and consequently behind the colon, and when depressed below the costal arch the area overlying it is usually tympanitic. A tumor of the kidney of considerable size may push the colon inwards toward the center line and in consequence be dull upon percussion.

Differentiated from Gall Bladder and Spleen.—An enlargement of the kidney on the right side is to be differentiated from an enlarged gall bladder by the presence or absence of the following conditions: A gall bladder is placed against the abdominal wall, consequently it is dull upon percussion The dullness of the gall bladder is continuous with that of the liver. The gall bladder if much enlarged cannot be pushed upwards beneath the ribs. It is superficial and nearer the median line than the kidney.

On the left side the kidney is to be differentiated from the spleen. The spleen is placed against the abdominal wall, is dull upon percussion and its sharp border, when much enlarged, can be felt beneath the costal arch.

CONGENITAL AFFECTIONS OF THE KIDNEY.—There may be but a single kidney, which usually is considerably enlarged. The kidneys may be fused, forming one large organ in the median line, constituting a so-called horse-shoe kidney. A kidney may be lobulated or completely divided. The ureter and pelvis may be double. The kidneys are sometimes located low in the pelvis, over the sacro-iliac synchondrosis. Normally the kidney has but a limited range of mobility. A palpable kidney is one the lower half of which can be felt on deep inspiration. A movable kidney has been defined as one which descends into the abdomen upon deep inspiration, so that its form can be defined and by manual pressure prevented from returning to its normal position. A floating kidney is one which can be pushed freely about the abdomen.

A movable kidney occurs ten times more frequently in women than in men, and is usually found on the right side in a proportion of twelve to one. This latter frequency is probably due to the position of the liver.

THE SUPPORTS OF THE KIDNEY.—The kidneys are supported and kept in position by their vessels, by the tension of the peritoneum, the maintenance of the intra-abdominal pressure and by a proper tone and contraction of the abdominal muscles. The kidneys become displaced in consequence of a lax and pendulous condition of the abdominal muscles. This interferes with the intra-abdominal tension. The kidneys are also displaced on account of a general process due to weakness or nerve exhaustion in which the abdominal organs become prolapsed. The absorption of much perinephritic fat, by decreasing tension, may be a causative factor. Sex, debility, weakness and the position of the liver are important factors in forcing the right kidney out of place. It has recently been claimed that the right kidney is pulled out of place by a band of connective tissue attached to the cæcum.

SYMPTOMS.—A movable kidney may cause little or no disturbance and be discovered accidentally while the patient is dressing or taking a bath. Ordinarily, however, it causes a great deal of functional disturbance, and in women a very decided nervousness. The majority of these patients are neurasthenics. There is usually a severe, heavy, dragging pain commencing in the lumbar region and extending downwards into the abdomen or pelvis. The pain is more severe when the patient is upon her feet and is frequently associated with disturbance of the stomach, such as nausea and vomiting. Occasionally a patient with a floating kidney will experience a severe, excruciating pain commencing in the lumbar region and extending into the bladder. These attacks come on suddenly, are attended with nausea and vomiting and swelling of the affected side. During the attack the patient voids but a small amount of urine, while with the relief of the pain the urine may be greatly increased in amount. These attacks are due to a kinking of the ureter and the damming up of the urine within the pelvis of the kidney. The kinking is caused by the rotation of the kidney around its perpendicular axis with torsion of the pedicle.

DIAGNOSIS.—The diagnosis will rest upon the above mentioned symptoms, coupled with the presence of a hard, freely movable tumor which is tympanitic and can readily be made to disappear beneath the ribs.

TREATMENT.—It must be taken into consideration that a loose kidney may be but one of several pathological conditions. For instance, there may

be a pendulous abdominal wall with falling of all of the abdominal viscera (splanchnoptosis). It should not be expected in such a case that fixation of the kidney alone will bring complete relief to the patient. If the displacement is only slight, it is generally recommended that the kidney be retained in position by placing a compress of gauze or cotton against the anterior abdominal wall of the affected side and just below the costal arch. This compress is held in position by a firm bandage around the body. Such treatment may succeed in the mildest of cases. If the kidney is freely movable and the condition of the patient warrants, it should be fixed.

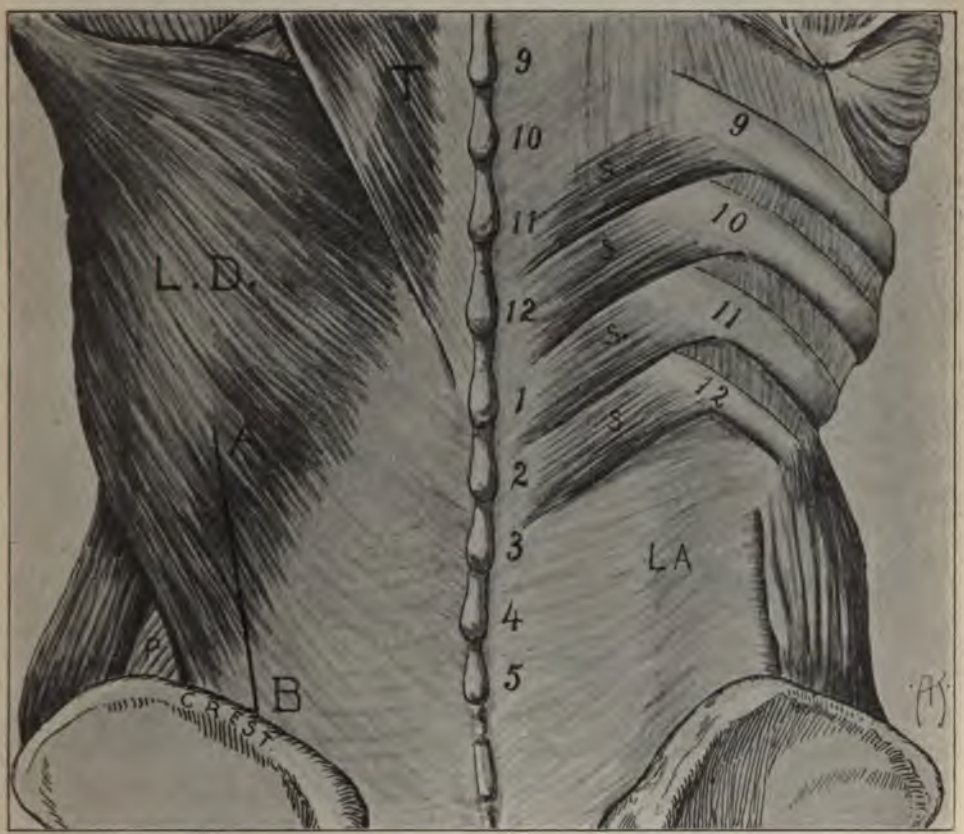


Fig. 118.—A-B.—Incision for exploring kidney. L. D.—Latissimus dorsi. T.—Trapezius. P.—Triangle of Petit. L. A.—Lumbar aponeurosis. SSSS.—Serratus posticus inf. A. B.—Line of incision.

The technic of the operation is as follows: As the patient is passing under the influence of the anæsthetic the side is scrubbed and prepared for operation. The patient is placed on the sound side with a large rubber air cushion or hard pillow beneath the loin for the purpose of elongating the space between the costal arch and the crest of the ilium on the side to be operated upon. A perpendicular incision is then made at the outer border

of the erector spinæ and from a little above the twelfth rib to the crest of the ilium (Fig. 118). The skin and fascia are incised, the fibers of the latissimus dorsi separated, the fascia of the internal oblique and transversalis divided, the fibers of the quadratus lumborum separated, and the anterior layer of the lumbar fascia divided (Figs. 119 and 120). There is ordinarily but very little hæmorrhage from the incision, and it is seldom that artery forceps have to be applied. The wound is now held widely open and the perinephritic fat torn through, exposing the kidney. Some slight caution will be necessary here not to work too far forward and injure the ascending colon or posterior parietal peritoneum. The perinephritic fat which is held in place by loose connective tissue is now clamped with heavy forceps

Fig. 119.—Anatomy of the lumbar region. Q. L.—Quadratus lumborum. M.—Multifidus spinæ. E. S.—Erector spinæ. I. C.—Ilio-costalis. L. D.—Longissimus dorsi. F.—Fascia transversalis.

on each side and the kidney pulled and pushed into the wound. The fatty capsule with its strands of connective tissue going to the colon are now completely stripped from the kidney and as much of this fat and connective tissue as is practical removed. The fibrous envelope of the kidney is then carefully divided in the median line over the dorsum and each half stripped back for about an inch. While the stripped capsule is held up, a needle carrying a chromicized cat-gut thread is made to pick up from the inside, half an inch of the capsule near the center of the kidney. A like cat-gut is inserted at the lower pole of the kidney and two on the opposite side in

corresponding positions. The needles are left attached to the sutures (Fig. 121). The kidney is now replaced. A needle carrying one of the upper threads is then passed through the lumbar fascia and quadratus lumborum muscle just below the twelfth rib and the thread knotted. A needle carrying one of the lower threads is passed through the same tissues about one inch and a half below the first and tied. The two sutures upon the opposite side of the kidney are treated in the same way. This drags the dorsum of the kidney well up beneath the ribs with its lower portion placed directly against the cut fascia and lumbar muscle. Through-and-through sutures of silk-worm-gut are then passed including all of the tissues down to the kidney. Before these are secured, the fascia and fibers of the quadratus are brought together by chromicized cat-gut sutures.

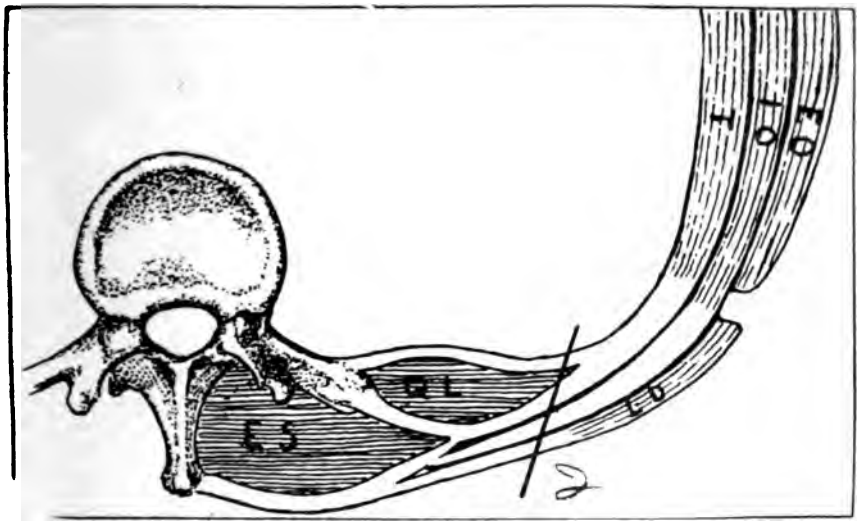
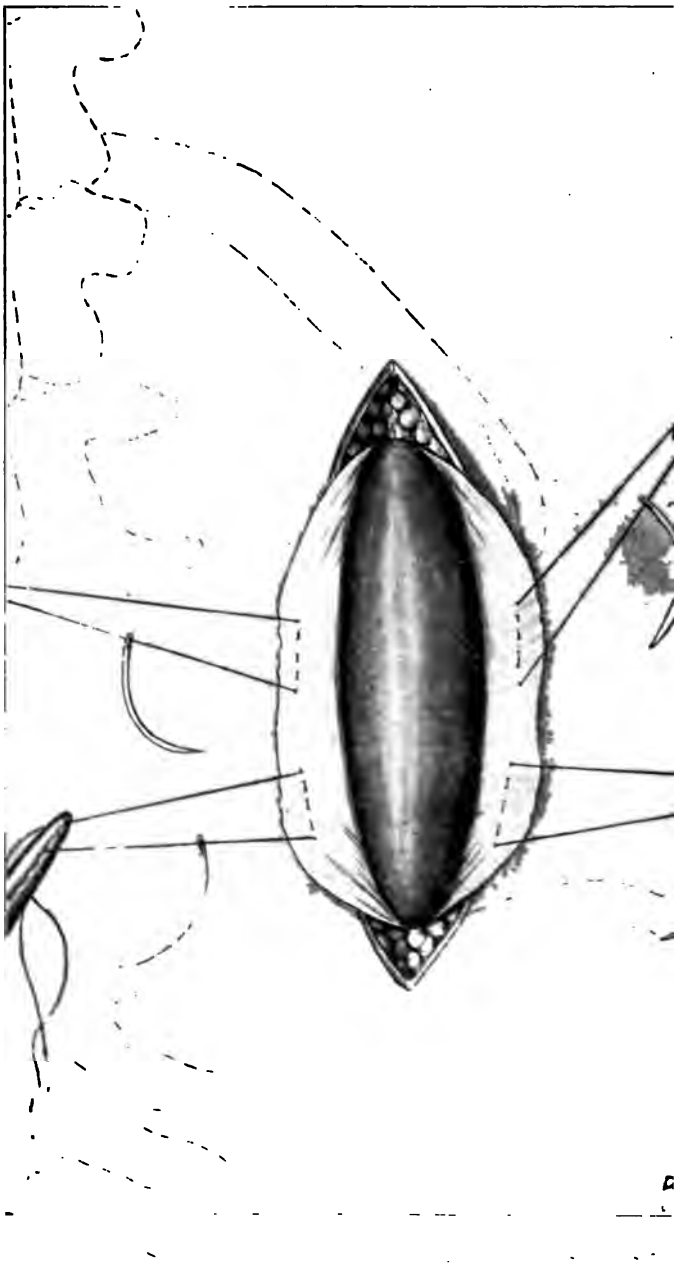


Fig. 120.—E. O.—External oblique. I. O.—Internal oblique. T.—Transversalis. L. D.—Latissimus dorsi. Q. L.—Quadratus lumborum. E. S.—Erector spinæ. I.—Line of incision.

There is usually primary union, with most satisfactory results. The risks of the operation are practically those of the anæsthetic.

INJURIES OF THE KIDNEY.

These are usually the result of some crushing force such as that caused by the passage of a heavy wagon wheel over the side, severe kicks or blows, or being crushed between the bumpers of cars. One of the serious conditions following injury of a kidney is hæmorrhage. This may be considerable at times, and even fatal. If the fibrous capsule is not ruptured the hæmorrhage will be confined to the kidney and its pelvis, the blood passing down the ureter into the bladder. While the hæmorrhage may continue in these cases for several days, it is usually not alarming. If the fibrous capsule is ruptured, the blood and urine are extravasated into the perinephritic tissues. The hæmorrhage in these cases is often alarming. It is likely to continue for several days. If the fibrous capsule is broken or its anterior sur-



face and the peritoneum torn, blood and urine will escape into the general peritoneal cavity, setting up a general peritonitis.

SYMPTOMS.—There will be shock, the severity of which will depend upon the extent of the injury and the susceptibility of the individual. Pain in the side, which is often severe, with localized tenderness, hæmaturia, nausea and vomiting. If the hemorrhage is considerable and the blood accumulates in the post-peritoneal space, there is likely to be very decided swelling, producing more or less of a diffused, hard, or at times fluctuating mass. If the blood and urine gain an entrance to the peritoneal cavity, there will be diffused tenderness with pain, tympanitis and the usual symptoms of a general peritonitis. If there has been very severe hemorrhage, there will be a feeble and quick pulse, pallor of the face and visible mucous membranes, ringing in the ears, vertigo, dilatation of the alæ nasi and cold perspiration. The process is usually followed by fever. If infection occurs, pain, tenderness and fever are increased with rigors and sweating.

TREATMENT.—If the fibrous capsule is not ruptured the conditions to be met are the control of hemorrhage and the relief of shock and pain. Hemorrhage is best controlled by putting the patient to bed and applying an ice bag to the side and giving ergot. At the same time the bowels should be kept open.

Shock, in consequence of the lowered blood pressure, is favorable for the arrest of hemorrhage, consequently while hemorrhage is going on the blood pressure should be maintained at the lowest point compatible with the well-being of the patient. For the relief of shock and the restoration of blood pressure, strychnine, caffine, morphine, and digitaline may be given subcutaneously. Carbonate or spirits of ammonia, camphor, and adrenalin are also beneficial for increasing the blood pressure. For the relief of pain, morphine or codein are most serviceable.

In cases in which the fibrous capsule is not ruptured these measures will ordinarily be sufficient to control the hemorrhage. If the capsule has been broken and the post-peritoneal space infiltrated, the kidney should be exposed by incision and if the laceration is not great or the hemorrhage severe, the rent may be closed by deep, quilted sutures of chromicized cat-gut, or the rent packed with iodoform gauze and the infiltrated area drained. If the kidney is severely lacerated and the hemorrhage pronounced, the kidney should be removed. In this case the kidney is lifted out of the wound and its pedicle ligated with silk or chromicized cat-gut. Following this the space is packed for a few days with idoform gauze. If blood and urine have entered the general peritoneal cavity, this cavity must be opened above the pubes and washed out with normal salt solution or some mild, antiseptic solution, and then drained. Drainage can only be satisfactorily carried out in these cases by placing large drainage tubes in the pelvis and putting the patient to bed in a sitting posture.

RUPTURE OF THE URETER.

This is a rare accident, but may occur as the result of a severe injury. Following rupture there is extravasation of the urine into the retro-peritoneal space with pain, the formation of a progressive swelling and probably chills. The treatment will consist in opening and draining the cavity, and, if pos-

sible, reuniting the torn ends of the ureter. In a few cases simple drainage has resulted in a cure.

If both ends of the ureter can be found after elongating the incision, they may be united by the Van Hook method. In carrying out this technic

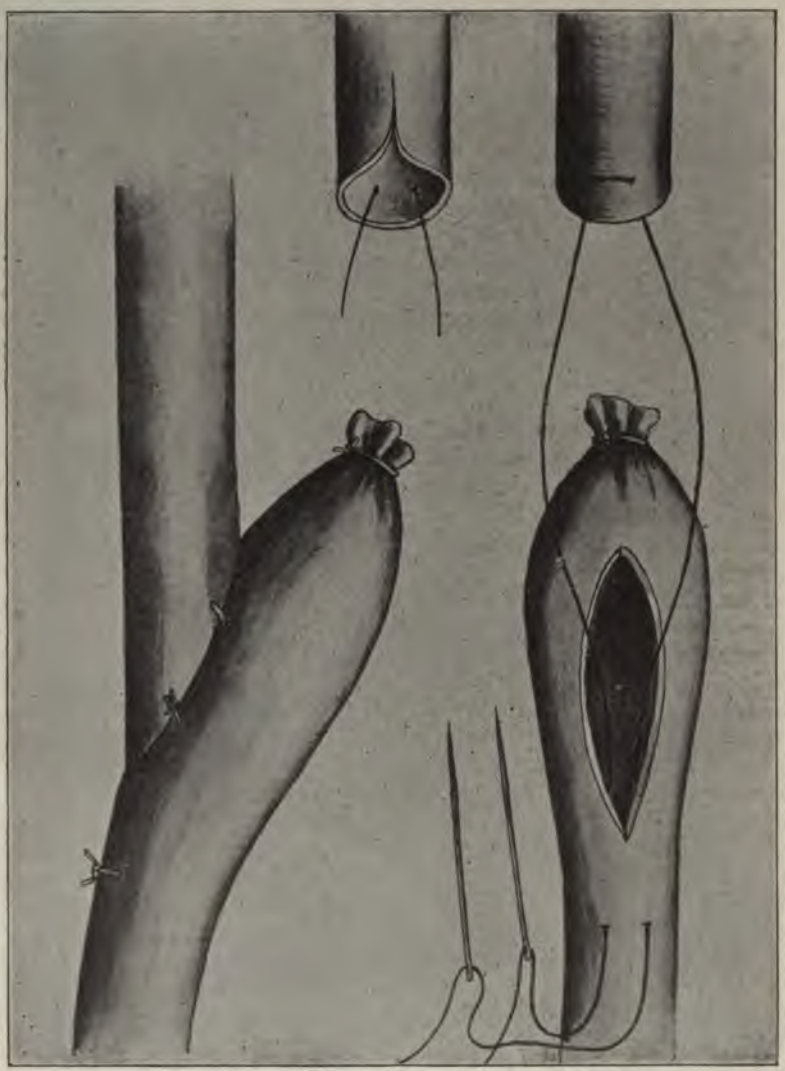


Fig. 122.—Van Hook's method of anastomosing the ureter.

the distal end of the ureter is ligated near its extremity and an incision made into the ureter just beyond the ligature and of sufficient length to admit the proximal end of the ureter. A slit, one-fourth of an inch long, is then made in the proximal end, and a fine silk thread or cat-gut threaded at both ends

Fig. 124.—Atrophy of kidney structure and formation of one great cyst with dilatation of ureter from obstruction of the bladder.

The threads are then knotted and the slit closed by sutures (Fig. 122). In cases in which an anastomosis cannot be effected and the wound will not heal as the result of drainage, the corresponding kidney may be removed, if the other kidney is healthy.

HYDRONEPHROSIS.

By this is meant an accumulation of urine in the pelvis and calyces of the kidney from obstruction. The condition may be congenital, and in that case is usually the result of faulty implantation of the ureter in the pelvis of the kidney, or the ureter may become obstructed by being drawn over an abnormally placed renal vessel. It may also be due to an impervious condition of the ureter. In the acquired form the cause may be a stone, blood clot, an inflammatory exudate, or a parasite arrested in the ureter. It may be due to kinking of the ureter, from a misplaced kidney, or to some pathological affection of the bladder such as a stone or tumor. A tumor outside of the bladder may, by pressure, cause obstruction in the ureter. The process may be unilateral or bilateral (Fig. 123).

If but one kidney is affected the process will be situated in the corresponding ureter. If both kidneys are affected the process will be in the bladder or below this. In order to develop a hydronephrosis the obstruction must be intermittent or incomplete. Some of the urine must escape, as complete and uninterrupted obstruction causes atrophy of the cells of the kidney and an arrest of urinary secretion.

Pathology.—Obstruction of the ureter causes dilatation of that part of the ureter situated above the obstruction with dilatation of the pelvis of the kidney and calyces. The pyramids are flattened and the cortex thinned and expanded. If the obstruction is continued the kidney tissue becomes atrophied and finally disappears. After six weeks of complete obstruction there is very little urine secreted (Fig. 124).

Clinical History.—This varies considerably. There may be severe and even excruciating pain. The kidney in these cases is very tender on palpation and gradually or quite rapidly increases in size until a fluctuating tumor is to be felt. The tumor may be the size of an adult head or be much larger than this. Not infrequently the enlargement is quite painless. In some cases infection occurs with abscess formation.

Diagnosis.—This will be made by considering the symptoms and course of the affection. The onset is usually gradual and may or may not be painful. The kidney slowly enlarges and may finally fluctuate. The tumor is situated beneath the peritoneum and consequently behind the colon. If it reaches a large size it will push the colon towards the center line and become dull upon percussion.

Treatment.—This consists in removing the cause, if this is possible. A floating kidney which rotates upon its axis and causes temporary obstruction should be anchored. Kinking of the ureter or stricture near its organ, may be corrected by dividing the ureter and re-implanting it in the pelvis of the kidney, or a plastic operation upon the ureter may be done. If the obstruction is due to some foreign substance this should be removed. When the obstruction cannot be relieved the kidney should be removed, provided the other kidney is healthy.

PYOGENIC INFECTION OF THE KIDNEY.

Infection of the kidney may have its origin from many different sources and give rise to several distinct pathological processes. An infected embolus may reach the kidney in a case of pyæmia and give rise to a diffuse inflammation with the formation of many small, or one large, abscesses. (*Acute suppurative interstitial nephritis.*) If the parenchyma of the kidney becomes involved the process is likely to spread to the pelvis, causing a pyelitis or a pyelo-nephritis. In consequence of a stone or tumor in the bladder, or stricture of the urethra, an infectious process may extend to the kidneys, producing an ascending pyelo-nephritis. If distention of the pelvis of the kidney is added to the infection, then the condition is known as pyonephrosis.

PYELITIS OR INFLAMMATION OF THE PELVIS AND CALYCES OF THE KIDNEY.

The causes of this affection, which are not necessarily associated with pyogenic infection, are lodgment of a calculus in the pelvis of the kidney, a tubercular focus, malignant disease, parasites, the effect of a cold and medicinal substances such as cantharides, cubebs, and copaiba. The process may be complicated by pyogenic infection. Infection is likely to follow in cases of long continued inflammation.

PATHOLOGY.—The mucous membrane becomes hyperæmic, inflamed and thickened. In consequence of the swelling the opening in the ureter may become narrowed or partially occluded, producing a hydro or pyonephrosis.

SYMPTOMS.—The symptoms of pyelitis with infection are pain and tenderness over the affected kidney, fever, frequency of micturition, swelling and the discharge of pus in an acid urine. The pus usually makes its appearance intermittently, in consequence of the opening of the ureter becoming obstructed for one or more days, during which time the urine is comparatively clear, while the fever, pain, tenderness and swelling increase. Then the obstruction may be relieved in consequence of the increased pressure within the pelvis and a quantity of pus-laden urine makes its way into the bladder, at this time the systemic symptoms are relieved. If there is at the same time decomposition of the urine within the pelvis of the kidney, the urine will be alkaline.

TREATMENT.—This should be directed primarily to the relief of the cause. If a calculus is present in the pelvis of the kidney this should be removed. If the process is secondary to kinking or torsion of the ureter from a misplaced or floating kidney, this condition should be corrected by re-implanting the ureter or fixing the kidney. If the process is one of infection coming from the bladder, this organ should be treated by frequent irrigations with antiseptic solutions, while internally urotropin or salol are administered. At the same time the patient should be put to bed and placed on a restricted diet and encouraged to drink considerable quantities of fresh water or milk. The bowels should be thoroughly opened. If these means do not relieve the condition, and the symptoms are increasing, and the pelvis infected, the kidney should be explored and either drained or removed.

PYELONEPHRITIS.

This is an inflammation of the renal parenchyma and pelvis of the kidney. The process is usually a suppurative one. The infection may be

secondary to a calculus or tuberculous process, or may ascend from the bladder, or be due to an infected embolus. It may also follow operations, injuries, parturition or the infectious fevers. During pyelitis, if there is much distention, the calyces becomes dilated, while infection extends to the interstitial tissue of the organ, with the result that many small or one large abscess is produced, or the parenchyma may in consequence of the pressure in the pelvis be absorbed, destruction going on until the whole organ is converted into a large pus-sac.

PATHOLOGY.—In pyelitis a certain degree of renal congestion exists. Bacteria invade the pyramids and travel up the tubes or lymphatics, producing an interstitial nephritis. This gives rise to abscesses, which may coalesce.

SYMPTOMS.—The condition is with difficulty differentiated from a pyelitis with infection. There is pain and tenderness over the region of the kidney. The pain may radiate across the abdomen or into the groin, and there is likely to be in men retraction of the testicle. If the obstruction is at all marked there will be a tumor with fever, the symptoms of septic absorption. The pus in this class of cases often makes up a very considerable portion of the urine voided; much more than in a case of ordinary cystitis. If a bottle is filled with the urine and allowed to stand, often one-sixth, one-fourth or one-third will be represented by the sediment which is largely pus. The amount of pus, however, varies frequently from day to day. Ordinarily the urine does not contain much mucus. The specific gravity is often low, not going above 1,006 to 1,016. The amount of urea is usually diminished, while albumin is always present.

COURSE AND DURATION.—Cases of traumatic pyelonephritis usually run a rapid course, and unless relieved by nephrectomy terminate in death. Pyæmic cases usually end fatally in a few days. Calculi and tubercular processes may last for years.

DIAGNOSIS.—This may be easy or difficult. Traumatic cases followed by hæmaturia and purulent urine are easy of diagnosis. If there is cystitis or other complications the diagnosis is not so easy. There are usually pain and tenderness over the affected kidney. If there is a tumor it will be round or oblong, elastic, and situated behind the peritoneum. There may be connective tissue threads and casts in the urine. The clinical history in acute cases will show infection with fever, rigors, pain and tenderness over the kidney and often vomiting with the passage of a small amount of urine. Pain, tenderness and enlargement of the kidney are among the characteristic symptoms. The amount of pus is large and the urine ordinarily acid. In the absence of localized pain over the kidney with frequent and painful micturition and pain over the bladder and in the rectum a cystitis may be suspected. If there is still doubt about the presence or absence of cystitis the bladder may be examined with a cystoscope. If there is an absence of cystitis the mucous membrane has a pearly-white appearance showing vessels crossing its surface. If it is inflamed it is dark-red and dull in color and has the appearance of a contused or inflamed mucous membrane. If a cystoscopic examination is not possible, the bladder may be thoroughly washed out until the water comes away clear, when the catheter is left in the bladder so that the urine as it comes from the kidneys will flow directly into a receptacle. If this urine contains quantities of pus it comes from the

kidneys. For the purpose of determining whether one or both kidneys are implicated, after thoroughly washing the bladder a segregator may be inserted and the urine secured directly from each kidney.

TREATMENT.—This may be in part internal and consist in the administration of the urinary antiseptics. If these do not relieve the condition the kidney should be explored and incised. If the process is due to calculus, the removal of the calculus and the drainage of the kidney is usually sufficient. A process due to pyogenic infection in which there is a single abscess may be cured by drainage. If the process is tubercular or the kidney, as is often the case, only a sac containing decomposing urine and pus, it should be removed.

PYONEPHROSIS.

This is a term used to indicate the association of pyelonephritis with distention of the pelvis, kidney, and ureter from obstruction to the flow of urine. It is usually due either to a calculus or tubercular process. If the obstruction is in the bladder the process is usually bilateral. The pelvis and calyces are dilated into one large or a great many smaller sacs. The kidney structure in some cases is scarcely recognizable.

SYMPTOMS.—The kidney is enlarged, tender, and painful. There are rigors, fever, loss of appetite and flesh. Pus is usually present in the urine, often in large quantities, and the urine may be either acid or alkaline. When both kidneys are enlarged the urine is usually scanty in amount. Nausea, vomiting, and toxæmia are then often present.

TREATMENT.—If the process is pyogenic and due to a calculus and the kidney not markedly disorganized, it should be incised, the calculus removed and the kidney drained. If both kidneys are involved operation is not permissible. Treatment should then be by internal medication.

ABSCESS OF THE KIDNEY.

This process follows infection of a kidney. The bacteria may gain access to the kidney from the bladder, as the result of some one of the acute infectious diseases, during an attack of pyæmia, or following an injury with or without an open wound. In pyæmia infected emboli may become arrested in the cortical substance, producing small abscesses.

SYMPTOMS.—These are not always pronounced or distinctive. There is likely to be pain and tenderness in the side, swelling, fever, and pus in the urine. When the amount of retained pus is very large the swelling will be very decided and there may be even a fluctuating tumor. The amount of pus in the urine is usually very variable. For two or three days there may be very little, then the amount discharged is large. The former condition not infrequently is attended with pain and swelling.

TREATMENT.—This consists in draining the abscess, provided the kidney is not seriously disorganized. If there is little more than a shell of kidney left nephrectomy should be done.

PERINEPHRITIS (SUPPURATIVE).

This may be caused by the extension of infection from within the kidney to the surrounding tissues, be the result of a wound with infection, or it may come from an infected appendix or from the intestine. The process

may be acute or chronic, depending upon whether it is pyogenic or tubercular.

SYMPTOMS.—In cases of pyogenic infection there will be pain, tenderness, diffuse swelling in the side with some rigidity of the spine and fever. The pus may take one of several routes, it may reach the surface on the outside of the erector spinæ, may burrow forwards in the abdominal wall, follow the colon into the pelvis, or it may rupture into the peritoneal or pleural cavities, or into the colon. There may or may not be pus in the urine, depending upon the condition of the kidney. In chronic cases the symptoms are less marked and less acute.

TREATMENT.—In the pyogenic cases free incision should be made in the pus cavity and drainage established. In tubercular cases if the kidney is implicated it should be removed.

TUBERCULOUS DISEASE OF THE KIDNEY.

This is a common affection and apparently occurs more frequently in women than in men. The disease may be considered under three heads.

(a) A tubercular process in the kidney may be but a part of a general acute miliary, tubercular infection in which all of the organs are more or less implicated. In this form there are no special symptoms and no treatment that is of any avail.

(b) A chronic, tubercular process of the kidney, which is secondary to a like condition of the testis, epididymis, or bladder. In this condition, as a rule, both kidneys are involved. There is an ascending infection which travels along the urinary tract to the kidneys, and as the result of this infection the mucous membrane of the ureters, the pelvis and calyces of the kidney become studded with tubercles. In these cases the mucous membrane is usually transformed into granulation tissue. The process may extend from the pelvis into the parenchyma, producing enlargement of the kidney. The patient finally succumbs as a result of exhaustion or uræmia. The treatment, except in a general way, is of no avail.

(c) Primary tuberculosis of the kidney. Hæmatogenic. It is probably true that in some, perhaps in many, of these cases the process is really secondary to a tuberculous process somewhere in the genito-urinary tract, in the tonsils, bronchial or lymph glands. Clinically, the process seemingly is local, because after the removal of the infected organ the patient ordinarily remains well. In these cases the bacilli are most frequently deposited within the glomeruli, although they may find their way into the uriniferous tubes, the mucous membrane of the pelvis, or upon the surface of the organ.

PATHOLOGY.—Three forms are described. The caseous form comprises 81 per cent., according to Israel's tables. In these cases the bacilli are usually deposited in one pole of the organ, most frequently in the lower pole. Tubercles are formed which coalesce, caseate, and form tuberculous abscesses. The process extends by continuity of structure until perhaps the entire organ is implicated, or the caseous area may remain more or less isolated, in which case the kidney is not much enlarged. The kidney in some patients reaches the size of an adult head, in consequence of the formation of many small or one large cavity. These cavities are filled with most offensive pus and decomposing urine. In this class of cases there is always

marked perinephritis, in consequence of which the kidney is firmly adherent to and difficult to separate from the surrounding structures. In the second class there are ulcers at the apices of the papillæ. In these there is usually marked hæmaturia. In the third form, the kidney is usually studded with hard nodules from the size of a pin's head to that of a marble. These nodules show no tendency to break down.

In tuberculosis of the kidney the pelvis is secondarily involved by the formation of tubercles within the mucous membrane. These coalesce, break

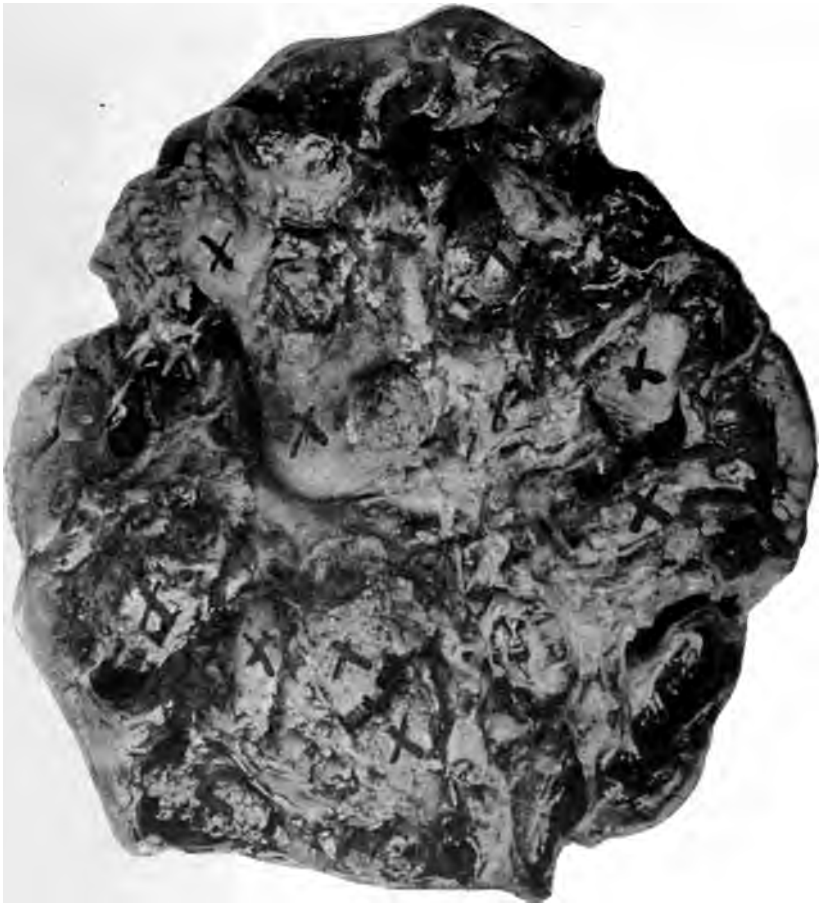


Fig. 125.—Tubercular kidney.

down, and form ulcers. The process may extend along the ureter and implicate the bladder.

SYMPTOMS.—The first symptoms are usually pain and tenderness in the kidney region. The pain is usually increased by active exercise. It may be represented by an aching which is more or less constant. These symptoms are usually followed by a rise of temperature, frequent urination and cloudy urine. The kidney becomes enlarged. All of the symptoms are likely to be

progressive. There is loss of appetite, emaciation, and loss of strength and occasional rigors. In cases in which the pelvis of the kidney is not implicated the urine for a long time may remain clear and acid.

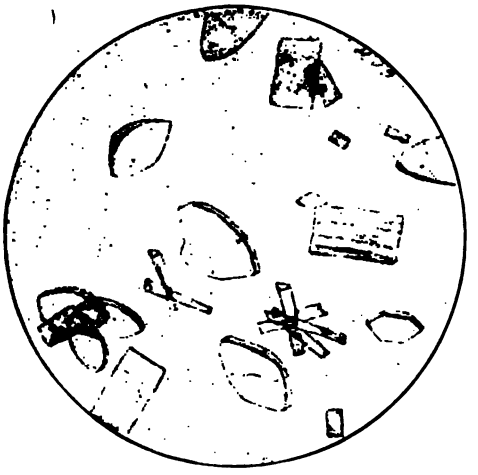


Fig. 126.—Uric acid crystals.

DIAGNOSIS.—This will rest upon the chronic course of the disease, the symptoms, the exclusion of calculus and pyogenic infection and, for a positive diagnosis, the detection of the bacillus of tuberculosis in the urine. In some cases a positive diagnosis cannot be established without an incision.

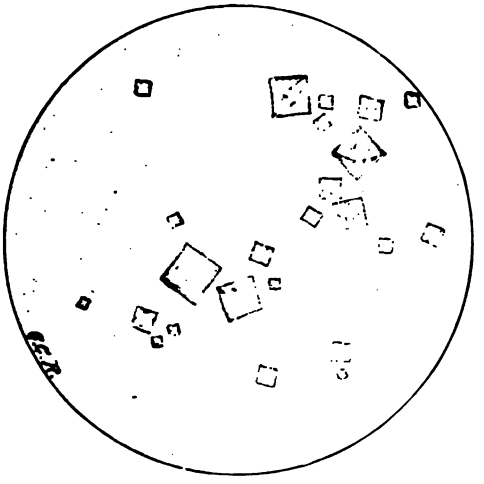


Fig. 127.—Oxalate of lime.

TREATMENT.—This consists in the removal of the affected organ, provided there is reason to believe the other kidney is healthy (Fig. 125).

Operation.—A perpendicular incision is made at the outer border of the erector spinæ and extending from the twelfth rib to the crest of the ilium.

The fibers of the latissimus dorsi are separated, the lumbar and transversalis fascia divided and the perinephritic fat divided or torn through. The kidney is then shelled out of its fatty capsule by the fingers. Aided by abdominal pressure, the surgeon then lifts the kidney out of the wound. The ureter is isolated and divided and its distal extremity cauterized with carbolic acid. The vessels are then ligated well away from the pelvis of the kidney with silk or cat-gut and the organ removed. In many cases in which the process is far advanced and there has been pronounced perinephritic inflammation the adhesions between the fibrous and fatty capsules and surrounding structures are very firm and difficult to separate. Again in consequence of the firm adhesions one or more abscesses are broken into during the enucleation; the operation should be proceeded with, however, and the kidney removed just as though this accident had not occurred. In some cases the perinephritic adhesions are so firm and strong and the kidney so large, extending upward beneath the ribs and downwards into the pelvis, that it is impossible to sep-

Fig. 128.—Triple phosphates.

arate the two capsules and enucleate the kidney with its fibrous capsule. In such instances it is best to divide the fibrous capsule and enucleate the kidney, leaving the capsule behind. Following the excision there is a considerable cavity, which it is well to pack lightly with iodoform gauze for a few days, bringing but a part of the wound together by sutures.

The results of nephrectomy for tuberculous infection confined to one kidney are extremely satisfactory.

RENAL CALCULUS—NEPHROLITHIASIS.

By this is meant the formation of a stone or stones within the kidney or pelvis produced by the deposit of the solid constituents of the urine.

Composition.—The majority of the kidney calculi are composed of uric acid, the urates of soda and ammonia and oxalate of lime (Figs. 126 and 127). The latter occurring alone or in combination with uric acid. Phosphatic calculi composed of calcium phosphate and ammonio-magnesium phos-

phate occur quite frequently in cases in which the ureter or one or more of the calyces become partially obstructed, with retention and decomposition of the urine (Fig. 128). Small calculi frequently occur in the pyramids during infantile life and are due to the deposit of uric acid, or the urates or oxalate of lime from an over acid and concentrated urine. In adults they are supposed to occur as the result of an over-indulgence in nitrogenous foods and in consequence of violent exercise when great tissue changes are going on. It is thought probable that the nuclei of many of these stones are particles of epithelium, mucus, blood clot, or clumps of bacteria. The calculi composed of uric acid and the urates that occur in an acid urine seldom reach a size larger than a hickory nut. They are round or oval, of a brownish color and quite hard. They are single or multiple. In some cases the pelvis of the kidney is so greatly dilated that it is a veritable gravel pit. In one of my cases 1,260 stones were removed from the pelvis of the kidney.

Fig. 129.—Free-stone of the kidney.

Phosphatic calculi or calculi composed primarily of uric acid and the urates upon which phosphatic deposits have occurred in an alkaline urine. These stones often reach a very large size. The phosphatic calculus frequently fills more or less completely the pelvis of the kidney and extends into the calyces, producing branching stones, which have been termed coral or tree calculi (Fig. 129). A calculus composed of oxalate of lime is of slow growth, very hard, white and has upon its outer surface many sharp nodes or spicules. It is often spoken of as a mulberry calculus (Fig. 130).

Pathological Changes.—These will depend upon the position, number, size and shape of the calculi. A single calculus imbedded in the substance of the kidney or encysted in the pelvis so as not to produce obstruction of the ureter, becomes surrounded by granulation tissue and if the area is not invaded by pyogenic organisms it produces no marked change in the kidney substance. A calculus which is more or less loose and which causes marked irritation followed by infection is likely to lead to suppurative pyelitis or pyelonephritis. A stone imbedded in the pelvis so as to produce

pressure on or intermittent obstruction of the ureter will lead to retention of urine and be followed by hydro or pyonephritis, with perhaps dilatation of the pelvis and kidney into a large sac (Fig. 131).

SYMPTOMS.—These will depend upon the size, number and position of

Fig. 130.—Kidney stones composed of oxalate of lime.

the calculi, as well as upon the presence or absence of infection. The ordinary symptoms of a renal calculus are pain, tenderness and hæmaturia, all of which are increased by active exercise. If infection occurs there will be pus in the urine. A small stone imbedded in the substance of the kidney

Fig. 131.—Free stones in the kidney.

with infection will produce more or less constant pain or aching in the lumbar region. The pain usually radiates down the ureter toward the bladder and is often associated in men with retraction of the testicle. There is seldom marked hæmaturia when the stone is encysted, but after active exer-

cise blood can usually be detected in the urine by the aid of the microscope. The pain is often paroxysmal and during the attacks there is increased frequency of micturition. If the stone is not encysted infection is likely to occur with pyuria and hæmaturia. The amount of pus in some cases is very large, although it varies from day to day on account of obstruction of the ureter by the stone or by purulent material.

Renal Colic.—This is defined as a paroxysmal pain starting in the loin and extending down the ureter towards the bladder and due to the impaction in or passage of a stone along the ureter. The paroxysms are usually of great severity and may last for a few minutes, when the pain suddenly ceases, or intermittently the pain may continue for a day or even longer. The paroxysms will continue until the stone is either driven into the bladder, finds its way back into the pelvis of the kidney, or the ureter becomes sufficiently dilated to allow the urine to pass by the obstruction. Severe paroxysms are always attended with nausea and vomiting and often marked shock or collapse. After the cessation of the paroxysms the urine is usually blood-stained. If the calculus becomes arrested within the ureter it may lead to ulceration, with rupture and the formation of a periureteral abscess.

Calculus Anuria.—As the result of the blocking of both ureters, or in consequence of the blocking of one and reflex action upon the other kidney, there may be a complete arrest of the urinary secretion. If the condition is not relieved by natural or artificial means, uræmia and death will follow.

Diagnosis of a Renal Calculus.—This will depend upon the symptoms, tenderness and possibly enlargement of the kidney and upon a radiograph examination.

Treatment.—In the prophylactic treatment the habits and diet of the patient should be regulated. Sweets and an excess of nitrogenous food should be avoided, while exercise is encouraged and the bowels regulated, preferably with salines. The patient should also be encouraged to drink freely of fresh water.

The curative treatment consists in the removal of the calculus. The technic will depend somewhat upon the size and number of the stones and the presence or absence of infection. For the location of the stone the kidney is brought into the wound and its entire surface, and that of the pelvis and ureter, palpated between the thumb and fingers. A stone that is the size of a pea can usually be located by this means. An encysted stone within the parenchyma of the kidney or pelvis may be cut directly down upon and removed, taking into consideration, of course, the renal circulation. After the removal the wound may be closed, if in the kidney, with quilted sutures and a strip of iodoform gauze packed about the incision. If the incision is in the pelvis of the kidney, this should be carefully closed by a continuous or interrupted suture. In the case of a large phosphatic stone associated with infection and considerable destruction of the kidney substance, the advisability of the removal of the kidney may well be considered. If the other kidney is healthy I believe the removal serves best the interest of the patient. If the removal is not thought best the kidney will have to be split wide open and the pelvis and calyces cleared of the phosphatic masses. The major portion of the kidney incision is closed by quilted sutures. Drainage is to

be provided for by means of a soft rubber tube supplemented by strips of gauze.

In cases in which the pelvis of the kidney is largely dilated, sacculated and filled with a great many stones with infection and probably with faulty implantation of the ureter, the pelvis should be incised, the stones removed and the ureter re-implanted in the lower portion of the pelvis or the kidney removed.

URETERAL CALCULUS.

A calculus imbedded in the upper portion of the ureter is readily reached through the incision made to expose the kidney. By prolonging this incision over the crest of the ilium, the ureter may be exposed almost to its junction with the bladder. In making the incision low down one must avoid opening the peritoneal cavity, while the peritoneum and abdominal contents are pushed towards the opposite side in order to expose the ureter. The stone being found, it is removed through a longitudinal incision and the opening closed. A wick of gauze may be pushed down to the site of the incision for drainage.

TUMORS OF THE KIDNEY.

These may be benign or malignant, solid or cystic, congenital or acquired. The benign tumors are frequently cystic, congenital and bilateral. The cystic tumor has its origin either in an obstruction of the ureter, or uriniferous tubules, or is due to the presence of remnants of the Wolffian body in the substance of the kidney. A portion of or the entire kidney may be affected. The kidney may not be especially enlarged or the tumor may reach the size of a cocoanut or be even larger than a man's head.

Symptoms and Diagnosis.—There are no special symptoms of this condition, if we exclude distention of the pelvis from obstruction. The kidney or kidneys slowly enlarge without pain, hæmaturia or special interference with the health of the patient. There is likely to be albumin in the urine, and later in the course of the disease the secretion of urine may be interfered with.

Dermoid and hydatid cysts have also been found within the kidney. If the hydatid cyst ruptures into the pelvis, characteristic cysts and hooklets may be found in the urine.

Prognosis.—This may be said ordinarily to be good, as these cystic conditions, if congenital, are not incompatible with old age.

Treatment.—Dermoid and hydatid cysts ought to be enucleated, while cystic disease of the kidney is not amenable to surgical treatment.

PAPILLOMA OF THE RENAL PELVIS.

In this condition there are villous and papillomatous masses developed from the walls of the pelvis of the kidney. The condition is rare and has usually been observed in people past middle life. A quite characteristic symptom which attends the process is hæmaturia without pain or enlargement of the kidney or interference with the health of the individual except as it is affected by the loss of blood. The process is differentiated from malignancy by the absence of pain and enlargement and the presence of good health.

TREATMENT.—The treatment consists in exposing the kidney, opening the pelvis and excising the growth. If the growth is very large a nephrectomy may be made.

MALIGNANT TUMORS OF THE KIDNEY.

These may be sarcomatous, endotheliomatous or carcinomatous. The malignant growths of the kidney are not confined to any period of life. They occur in infancy and old age. They usually are rapidly growing, unilateral and very malignant growths, which early interfere with the health and well-being of the individual. In malignant disease of the kidney there is fever loss of flesh and strength, and usually severe but intermittent hæmaturia The hemorrhage may continue for a day or two or several weeks and then disappear for a shorter or a longer period. The passage of ribbon-like clots of blood may cause symptoms of renal colic.

TREATMENT.—The treatment is the removal of the kidney at the earliest possible moment that a diagnosis can be made.

INDICATIONS FOR NEPHRECTOMY.

(a) If tubercular disease is confined to one kidney.

(b) If malignant disease is confined to one kidney.

(c) For calculus pyonephrosis confined to one kidney, when the structure of the kidney is practically destroyed.

(d) For hydronephrosis when palliative means have failed to give relief

(e) For some cases of ruptured ureter.

(f) For severe traumatic lesions of the kidney attended with severe hemorrhage.

CONGENITAL AFFECTIONS OF THE BLADDER.

ECTOPIA VESICAE, EXTROVERSION OR EXSTROPHY OF THE BLADDER

There is here a congenital failure of union in the lower abdominal walls, pubic bones and bladder. In some cases the pubic bones and bladder wall are not cleft. In these the bladder is pushed prominently forward in consequence of the intra-abdominal pressure and the cleft in the abdominal walls. When the bladder is cleft the posterior wall is forced forwards and appears as a raw surface upon which the orifices of the ureters can be seen and from which the urine escapes in small jets. In the infant the exposed bladder wall is often not more than an inch or two in diameter In some cases the symphysis pubis is absent and the horizontal rami of the pubic arch extend not further than the inguinal region. In males the condition is usually associated with that of epispadias and cryptorchidism. In females the urethra is usually only a groove, while there are often malformations of the vagina and uterus. In consequence of papillary growths about the orifice of the ureters, obstruction with dilatation of the ureters and pelves of the kidneys is liable to occur. Cystitis is always present and infection of the higher urinary tract is frequent. In consequence of the continued escape of urine the skin of the lower abdomen becomes excoriated.

TREATMENT.—In non-operative cases an attempt should be made to protect the surrounding skin as much as possible from the escaping urine

The parts should be carefully cleansed two or three times a day and then protected by bismuth, zinc oxide, or starch powder. In mild cases some relief may be obtained by the wearing of a well-fitting urinal.

The surgical treatment is difficult and often unsatisfactory. This is in a measure due to the fact that there is little or no bladder cavity. The treatment consists in creating a cavity by separating the bladder in part from its peripheral attachments and then folding it in upon itself, or in closing the defect in the bladder-wall by taking skin flaps from above or from the sides and bringing them down over the defect, where they are united, the skin surfaces forming the anterior wall of the bladder.

TRAUMATIC AFFECTIONS OF THE BLADDER.

(a) The injury may be due to direct violence applied to an over-distended bladder; (b) to a punctured wound: or (c) to a fracture of the pelvic arch. The bladder may also be opened by progressive ulceration, especially as the result of an encysted stone. Ruptures are divided into extra- and intra-peritoneal. The peritoneum covers the posterior and superior walls of the bladder, being reflected above on to the abdominal wall along the urachus, at the sides along the obliterated hypogastric arteries and posteriorly on to the rectum.

SYMPTOMS.—*Intra-peritoneal Rupture.* There is usually severe shock with intense pain in the lower abdomen, followed by symptoms of peritonitis, frequent desire to micturate with the passage of a little blood-stained urine. In extra-peritoneal rupture there will be localized pain, tenderness, perhaps extravasation of urine, frequent desire to micturate, with the passage of blood-stained urine.

TREATMENT.—In intra-peritoneal rupture an immediate laparotomy should be done, the bladder closed by tier sutures, the innermost of which should be cat-gut. The abdomen is then drained, with the patient in a sitting posture, and a catheter retained in the bladder. In the absence of extravasation, rest in bed with the relief of pain, opening of the bowels, avoidance of overdistension of the bladder with the use of the urinary antiseptics, are the most helpful means of treatment. If extravasation occurs the areas in which the urine has passed must be well drained by free incision and the catheter retained in the bladder.

FOREIGN BODIES.

Occasionally pencils, bougies, pins and other foreign substances are accidentally or intentionally introduced into the bladder. In a case, recently under my care, a patient during catheterization, developed an erection, causing the catheter suddenly to slip into the bladder. It was readily extracted with a lithotrite. If a foreign substance is allowed to remain in the bladder it causes irritation, cystitis and ammoniacal urine. The foreign substance in a day or two becomes coated with phosphatic deposits. If the foreign substance is soft, like a catheter or bougie, it can be extracted with a lithotrite. If it is a steel pin or other hard substance, and cannot be broken up with a lithotrite, a cystotomy should be done. In a woman the urethra may be dilated and the extraction thereby rendered easier.

CYSTITIS OR INFLAMMATION OF THE BLADDER.

Inflammation of the bladder, while usually due to bacterial infection is favored by a number of collateral conditions. Among these may b mentioned retention of urine, the presence of stone, exposure to cold, urin which is highly irritating, and lesions of the spinal cord.

Bacteria.—The bacteria most frequently present are the bacillus col communis, the proteus vulgaris, the streptococci, staphylococci and diplococci The most frequent seats of the inflammation are the trigone, and the uretera orifices. In acute cases the mucous membrane becomes hyperæmic, thick ened, and the site of a profuse muco-purulent secretion. In cases of lon standing pockets or sacs are formed, over which the wall of the bladde may be very thin. Ulcers are also frequent in chronic cystitis. In cases o paralysis gangrenous cystitis has been known to occur in which the mucou membrane covering the trigone necrosed and came away in large slough leading to perforation.

Pseudo-Membraneous Cystitis.—This may be due to a severe infectio and ammoniacal decomposition of the urine in connection with paralysis and in women it may occur after labor. The membrane is composed o fibrous and epithelial tissue, or there may be exfoliation of the mucous mem brane itself.

Routes of Infection.—The channels by which the micro-organisms reac the bladder are various. The most frequent is by the way of the urethra the germs being carried in with instruments or extending backwards alon the urethra to the bladder in cases of urethritis. In women cystitis is fre quently developed in consequence of infection in adjacent organs as th broad ligaments, or in consequence of a pelvic abscess. The micro-organ isms reach the bladder in these cases in consequence of the contiguity o structure. The bladder may also be infected by pus coming from the kid neys or through the lymphatics or blood from a wound.

SYMPTOMS.—*Acute Cystitis.* In acute cases there is painful and fre quent micturition, pain over the hypogastrium and in the perineum and rec tum. The patient is often obliged to pass his urine every half hour an when the desire comes it is impossible for him to prevent the escape of urine Following micturition there is often severe tenesmus. In some cases ther is high fever, while in others the rise in temperature is only slight. The urin is ammoniacal, very offensive and contains quantities of pus and mucus.

PROGNOSIS.—This is usually good, but death may result from exhaus tion, pain, inability to sleep, peritonitis, toxæmia, or the extension of th infection to the kidneys.

TREATMENT.—If practicable the patient should be put to bed, given light diet, encouraged to drink freely of bland liquids and to keep the bowel open with salines. Internally, urotropin or salol, with quinine if there i fever, should be administered. In extra acute cases where the symptoms ar violent and not readily controlled by the above means, the bladder shoul be drained supra-pubically. In cases which are not so acute, irrigation of th bladder through a soft catheter with a hot but mild antiseptic solution, sucl as carbolic acid, one-half drachm to a quart, permanganate of potash, 1 t 10,000, or a lysol solution, may be practiced to advantage.

Injections.—In these cases but a few ounces should be introduced at a time so as not to distend the bladder. If the irrigations are not well borne, one to three drachms of a nitrate of silver solution of the strength of one-half or one grain to an ounce may be instilled into the bladder.

In cases where the pain is severe and the symptoms pronounced, ice may be applied over the hypogastrium. Marked relief is often also obtained by hot sitz-baths. Morphine may be given as the case requires, either hypodermically or in suppositories per rectum.

CHRONIC CYSTITIS.

This is often but the sequence of an acute attack or of a chronic urethritis. It is often associated with some obstruction, such as enlarged prostate, a stricture or some irritation, such as that caused by a tumor or foreign body. It may also be due to tubercular infection. The symptoms are pain, frequency of micturition and ammoniacal and offensive urine, containing pus, mucus and epithelial cells.

COURSE.—If relief is not obtained the patient's health is finally impaired in consequence of the distress, inability to sleep, loss of appetite, and possibly the occurrence of pyelonephritis.

DIAGNOSIS.—This will depend upon the symptoms, pain, frequency of micturition and alkaline urine containing phosphates, mucus, pus and epithelial cells. A cystitis must be differentiated from urethritis and from pyelitis. The absence of discharge from the meatus, the pain and frequency of micturition and the two-glass test showing pus in the second glass are usually sufficient to exclude urethritis. In pyelitis there is usually pain in and enlargement of the kidney, the urine may be acid and the amount of pus in it often very large, the sediment amounting perhaps to one-fourth or even more of the entire quantity. Without cystitis there is an absence of pain or frequency in urinating.

TREATMENT.—Before instituting treatment the cause of a chronic cyctitis should be determined, and if possible removed. If there is a stricture or gleet, these conditions should be relieved. If there is an enlarged prostate with residual and ammoniacal urine, it may be necessary to do a prostatectomy. If there is a calculus this should be removed.

Internal Treatment.—The diet should be plain and non-irritating, with an avoidance of acids and alcoholics. The bowels should be kept open and the exercise be mild. Internally, salol or urotropin may be administered.

Local Treatment.—The bladder should be irrigated once each day with a mild antiseptic solution, care being taken in the irrigation that the bladder is not over-distended. In cases which are rebellious to the above treatment, one to two drachms of nitrate of silver solution of the strength of one-half grain to eight grains to an ounce may be instilled into the bladder every two or three days. Cystotomy will seldom be necessary for chronic cystitis, except for the removal of the prostate, a calculus or tumor.

TUBERCULOUS DISEASE OF THE BLADDER.

This process is most common in men under forty years of age, and it may be primary or secondary. It may be secondary to tubercular infection of the kidney, testicle, prostate, seminal vesicles and large intestine. Pri-

marily the infection implicates the mouths of the ureters or the trigone, the lesion progresses, ulcers occur and these may undermine the mucous membrane and lead to perforation. The symptoms are those of a chronic cystitis associated with hæmaturia. The diagnosis is made by the discovery of the bacillus of tuberculosis in the urine.

PROGNOSIS.—This is on the whole unfavorable. The ulcers increase in size and the patient finally becomes exhausted as the result of the pain, the extension of the disease and general infection.

TREATMENT.—The hygienic and internal treatment of tuberculosis of the bladder is that of the disease in general. Protonuclein is, however, recommended by some as acting most favorably upon this condition when given internally.

In the local treatment the bladder may be washed out each day or second day, following which two drachms of a ten per cent. solution of iodoform

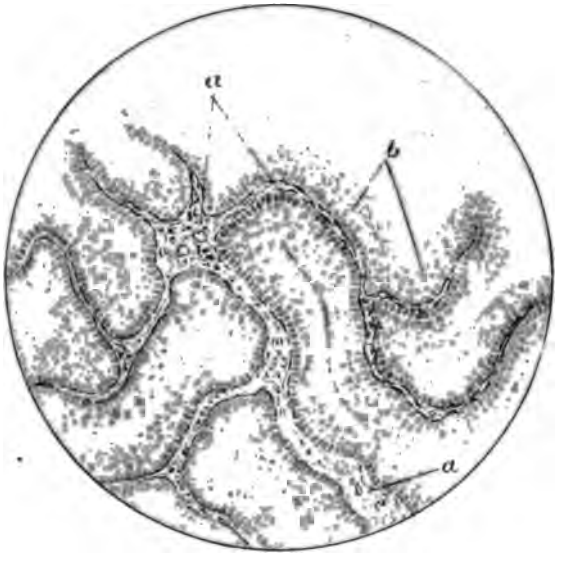


Fig. 132.—Papilloma of bladder. a.—Connective tissue of papillæ. b.—Proliferation of bladder epithelium.

in glycerine is injected, and in addition to this, once or twice a week, a solution of silver nitrate may be instilled into the bladder. In very severe cases the bladder may be drained.

TUMORS OF THE BLADDER

These are not common. Almost every species of tumor may be met with in the bladder; the benign villous or papillomatous growths and the malignant neoplasms are the most common. The villous growths appear as soft, wavy, delicate sessile masses usually attached to the base of the bladder, near a ureteral orifice. They are made up of delicate stems of connective tissue carrying blood vessels and surrounded by layers of epithelium. These papillomatous growths may be single or multiple. The most pronounced symptom is hemorrhage into the bladder. This comes on without apparent

cause. At first it seems to be slight, lasting perhaps not more than a day or two, and then disappearing for weeks or months. When it returns it is likely to be more severe and last longer than on the first occasion. The blood is bright red and often very considerable. It is caused by the rupture of some of the delicate processes which carry blood vessels. The amount of blood lost is usually progressive. There may be irritation of the bladder with increased frequency of urination. Often there is neither pain nor marked functional disturbance (Fig. 132).

DIAGNOSIS.—This is made by considering the bright red color of the blood, the facts that the hemorrhage recurs with greater frequency and intensity, that there is slight irritation of the bladder with some pain and tenderness on pressure, and an absence of disturbance of the kidneys. A positive diagnosis can only be made during the intervals of bleeding by a cystoscopic examination of the bladder. If the fluid within the bladder is quite clear the various filaments of the growth can be seen waving backward and forward like the branches of a tree in a summer's breeze.

PROGNOSIS.—This may ordinarily be said to be good, as the growths are usually benign. There is, however, a slight tendency for these tumors to recur after removal, and also a disposition towards malignancy. The further fact should be taken into consideration that the patients are often debilitated by the amount of blood lost.

TREATMENT.—Ergot may be given internally and injections of hot carbolized water used for the purpose of arresting the hemorrhage. The curative treatment consists in the removal of the growth. The bladder may be opened above the pubis, through the perineum or through the vagina in women. The growth is exposed and removed with the mucous membrane by shears curved on the flat, by post-pharyngeal forceps, or with a curette. Following this the wound may be closed by one or two cat-gut stitches, or cauterized.

MALIGNANT GROWTHS.

The malignant growths are the sarcoma, endothelioma and carcinoma. The sarcomata come from the connective tissue of the bladder wall and may form large, rapidly-growing tumors, which project into the cavity of the bladder. The endotheliomata have their origin from the endothelial cells of the lymphatics and blood vessels. They may also form large tumors projecting into the cavity of the bladder. The carcinomata come from the epithelial cells of the mucous membrane and take the form of epitheliomatous growths.

The malignant growths of the bladder are more frequent in men than in women. The sarcomata occur in the young and the carcinomata during old age.

SYMPTOMS. There is likely to be profuse hemorrhage from the bladder, pain and tenderness, frequency of micturition with symptoms of cystitis. A tumor interferes with the health and well-being of the individual, and there is loss of flesh.

DIAGNOSIS. This will depend upon the above named symptoms in addition to which small particles of the tumor may be found with the urine. A cystoscopic examination may be of advantage.

PROGNOSIS.—This is very unfavorable.

TREATMENT.—If the growth is seen early, and is well circumscribed, it may be removed, taking out a part of, or the entire thickness of the wall of the bladder. The wound should then be united by chromicized cat-gut sutures. In cases which are not seen early enough for operation the indications for treatment are the relief of pain and the control of hemorrhage.

FUNCTIONAL DERANGEMENTS OF THE BLADDER—INCONTINENCE OF URINE.

This is a condition in which the urine escapes involuntarily. It has been divided into active and passive incontinence. Active incontinence is often present in childhood and results from some increased excitability of the urinary apparatus or from some weakness of the sphincter. The predisposing conditions to active incontinence may be phimosis, masturbation, high specific gravity of the urine, irritation of the rectum and an unstable condition of the nervous system. The condition is thought by some to be allied to chorea. The incontinence is frequently active only at night and results in the child wetting the bed. It may be active in the day, in consequence of which the child's clothing is more or less constantly wet. The condition more frequently affects boys than girls, in some instances several members of the family will be afflicted.

TREATMENT.—Every cause of local irritation should receive attention. Ascarides, rectal polypi, masturbation, over-acid conditions of the urine and an unstable condition of the nervous system should be corrected. The children are nearly always nervous and weakly, and for these conditions iron, arsenic, strychnin and quinine are often serviceable. Belladonna and the bromides may be given to advantage. In obstinate cases, in female children, the injection of a few drops of paraffin solution into the region of the sphincter may give satisfactory results.

Passive Incontinence.—This is present when the sphincter vesicæ is involved as the result of some injury or disease of the spinal cord, the urine making its escape as it enters the bladder. Any injury or disease of the center governing the sphincter produces permanent incontinence. If the detrusor center is injured or destroyed, while the sphincter center remains intact, the urine will accumulate in the bladder until it becomes overfilled, when the incontinence of over-distention will occur. The functions of these centers may be temporarily arrested as the result of shock or great mental disturbance. It may then be quickly recovered from, but if the center is destroyed the function is permanently lost.

RETENTION OF URINE. WITH OR WITHOUT INCONTINENCE.

This condition is due to a variety of causes. Anything which obstructs the flow of urine, whether this obstruction be partial or complete, will lead necessarily to retention. If at each micturition the patient is unable fully to empty his bladder, as so frequently occurs with enlarged prostates, he has what is known as residual urine. The amount of residual urine may increase day by day, until the bladder becomes greatly distended and the urine dribbles away involuntarily from the incontinence of over-distention. Not infrequently in old men with slight atony of the bladder and enlarged

prostate, complete retention occurs as the result of exposure to cold during a drive or in consequence of drinking a glass of cold beer. Retention may also be due to phimosis, urethral calculus, organic stricture of the urethra, spasmodic stricture, or inflammatory exudate in the perineum. In the prostatic region, obstruction may be due to hypertrophy of the prostate, calculus, tumor or inflammatory exudate, atony of the bladder, paralysis, tumors, and reflex irritation such as occurs after operations on the rectum.

TREATMENT.—This consists in the removal of the cause in so far as it is practicable, in the gradual withdrawal of the urine under antiseptic precautions, and in the restoration of the normal tone and muscular power of the bladder. Enlarged prostate, phimosis, calculus, stricture, rupture of the

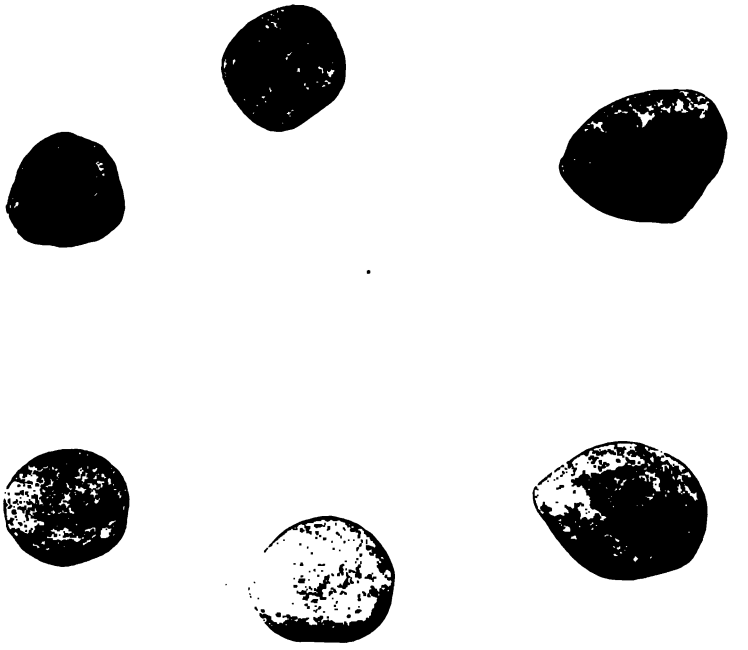


Fig. 133.—Stones composed of urate of ammonia and soda.

urethra, abscess in the perineum, and tumors can be dealt with surgically. Atony of the bladder in which there is loss of muscular tone, often from over-distention, is treated by the withdrawal of the urine, the administration of strychnin in full doses and the use of electricity. When the bladder has been over-distended for a day or more, the greatest care should be exercised in withdrawing the urine. But a small portion of that present in the bladder is withdrawn at a sitting and part, perhaps one-half of the fluid withdrawn, is replaced by a warm sterilized solution of boric acid. The amount withdrawn is increased each time, until the bladder is empty. If the bladder has been distended for any considerable time and the urine all withdrawn at once, a violent cystitis, in consequence of the atony of the muscular wall of the bladder and the loss of internal support, coupled with infection, is likely to occur.

STONE IN THE BLADDER.

A vesical calculus may be formed of uric acid, urate of ammonia or soda, oxalate of lime, the phosphates, cystin, or xanthin. About two-thirds of all the vesical calculi occurring in acid urine are composed of uric acid crystals. The uric acid calculus is light or dark brown, hard, reasonably smooth and of an oval or flattened shape. They are especially frequent in children. Urate of ammonia or soda, either alone or in combination with uric acid, may form stones in acid urine. These are similar in appearance to the uric acid calculi. They are, however, lighter in color and not so distinctly laminated (Fig. 133).

Fig. 134.—Bottle containing the debris of a crushed oxalate of lime calculus.

Oxalate of Lime Calculus.—The crystals of oxalate of lime form about three per cent. of the bladder stones. They occur as white, very hard, slowly growing calculi, having a nodular or mulberry surface. They seldom reach any considerable size (Fig. 134).

Phosphatic Calculi.—These stones occur in alkaline urine and with special frequency in cases of cystitis. The sediment in these cases is usually composed of triple-phosphates in the form of hexagonal prisms. These calculi are soft, grow rapidly and are of a dirty, gray color. They occur with especial frequency in cases of stricture or enlarged prostate. Stones composed of cystin and xanthin are rare (Fig. 135).

CAUSES.—Uric acid calculi and calculi composed of the urates are formed in over-acid and concentrated urine. The oxalate of lime calculi

occur with special frequency in persons who are nervous or are suffering from nervous exhaustion. Particles of blood, mucus, or epithelial cells may form the nucleus for a calculus. Any substance which acts as a foreign body may cause urinary deposits and be the starting point for the formation of a calculus. In the bladder there may be a single calculus or there may be many.

SYMPTOMS.—Pain in the bladder and perineum along the urethra, and especially at the end of the penis immediately after micturition, are very common symptoms. The pain is increased by active exercise, and is often

Fig. 135.—Two enormous stones composed of the triple phosphates. Removed from a female bladder by vaginal section.

associated with hæmaturia. Occasionally the patient complains of a sudden stopping of the flow of urine, requiring a change of position before the flow can be started, or the patient may be obliged to get into some peculiar position in order to empty his bladder. Primarily and before the bladder is very much irritated the urine may be quite clear and acid. If the stone is of considerable size there is likely to be quite a marked cystitis, with alkaline urine containing pus, blood, and mucus. The bladder walls become hyper-

trophied and at times sacculated, and the infection from the bladder may extend to the kidneys.

DIAGNOSIS.—This can only be made by sounding the bladder. The bladder should contain from six to eight ounces of fluid and a Thompson's searcher, or a suitable sized sound having a short beak may be used. Under antiseptic precautions the sound is passed into the bladder and rotated gently in every direction. It is carried forwards and backwards and to the sides, with the beak elevated and then depressed, and finally the point is turned backwards in order to explore the region behind the prostate. If a stone is encountered a distinct metallic clink is experienced, which can be both felt and heard. The grating, which is sometimes produced by the sound passing through a deep urethral stricture, or over fibrous bands, must not be mistaken for the metallic ring of a stone.

TREATMENT.—Vesical calculi should either be removed by incision of crushed and the fragments washed out (*lithotrity*). In the cutting operation the bladder may be entered above the pubis (*supra-pubic cystotomy*), or through the perineum (*perineal cystotomy*). The patient is prepared for the operation by being confined to the bed for one or two days while the bladder is washed out with an antiseptic solution night and morning and the bowels thoroughly opened. For several days previous to the operation it is well to give either salol or urotropin for their antiseptic effect upon the urinary tract.

In *supra-pubic cystotomy* the patient is placed in a Trendelenburg position and the bladder distended with a boric acid solution until it rises above the pubis. The solution is retained within the bladder in men by tying a tape about the penis. An incision about two inches long is then made just above the pubis and in the median line. The tissues comprising the linea alba are divided and the surgeon makes his way carefully through the underlying fat until the wall of the bladder is reached.

There are a few conditions which it is necessary to observe during the operation. The most important is to avoid injury of the peritoneum by not carrying the incision more than two inches above the upper border of the pubis; often one and one-half inches is sufficient. The peritoneum is carried upwards by distending the bladder with fluid and by the Trendelenburg position. It will also be of assistance in avoiding injury to the peritoneum to draw the deep parts of the wound upwards by a dull retractor. Next, disturb the tissues and the vesical fat as little as possible during the operation. Third, avoid any large veins which may ramify in the center line. When the wall of the bladder has been exposed it should be caught up in the center line by a sharp tenaculum and strong traction sutures introduced on each side of the tenaculum. These sutures are for the purpose of steadying the bladder and defining the opening after the incision. An incision is then made from above downwards through the bladder wall for about one inch or one inch and a half, the forefinger introduced and the stone identified. A pair of suitable lithotomy forceps is passed along the side of the finger and the stone extracted.

As the bladder is practically always in a septic condition, it will require drainage. Before introducing a tube two or three cat-gut sutures should be passed through the wall of the bladder and the tissues of the linea alba

and tied. A drainage tube is then introduced into the bladder and the uri siphoned into a receptacle containing some antiseptic fluid, placed at the si of the bed. The bladder is usually irrigated night and morning and m be closed in three or four weeks with granulation tissue.

Perineal Cystotomy.—This route for the purpose of reaching the bla der is often preferable in elderly persons with enlarged prostate.

After proper preparation, the patient is anæsthetized and placed in exaggerated lithotomy position with the thighs pressed close down to abdomen. As a preliminary to the operation the rectum should be thorougi scrubbed out by an assistant. A staff is then passed into the bladder. T incision should commence in the middle line about two and one-half inc above the rectum and be carried downwards in the median line or to patient's left for two inches. The groove in the staff is then identified the point of the knife made to incise the membranous portion of the ureth The knife can then be readily pushed along the groove into the bladder, w the handle of the staff is depressed, or the prostatic urethra may be dila with the finger or a uterine dilator. With the finger in the bladder a p of suitable forceps is introduced and the stone or stones extracted. I prostate is considerably enlarged it may be enucleated through the sa incision. A soft rubber catheter is now introduced and the bladder was out. Following this a long rubber tube reaching a vessel beneath th is introduced for the purpose of siphoning off the urine. The bladder usually washed out night and morning. After four, two to four days tube may be removed and the wound allowed to close by the formation

ments usually fall at about the original site of the stone, and by keeping nstrument in about the same position the fragments may be seized suc- vely and crushed. When all of the large fragments have been dealt the instrument is closed and withdrawn and a large evacuating catheter

Fig. 136.—Lithotrite.

Fig. 137.—Bulb glass receiver and evacuating catheter.

oduced and the bloody fluid allowed to escape. Two or three ounces warm boric acid solution are then injected. The evacuator filled with m sterilized water is then attached to the catheter and the bulb com- ssed, driving the fluid into the bladder. The bulb is then allowed to ex-

[illegible] into the bulb will carry with it [illegible] of the broken down stone. These [illegible] of the glass receiver, where they [illegible] relaxed successively until no more [illegible] of stone are still left in the blad- [illegible] and the lithotrite re-introduced [illegible] until the bladder is free from frag- [illegible] boric acid solution should be left in

[illegible] kept in bed for a few days, the urine [illegible] necessary and the bladder irrigated. [illegible] allowed to get out of bed in two or

[illegible] develop are fever, chills, acute cystitis, [illegible] of the urine. None of these com- [illegible]. Death may occur from perforation of

[illegible] PROSTATE—ACUTE PROSTATITIS.

[illegible] gonorrhœal infection. The inflammatory [illegible] prostatic urethra. It may occur as the re- [illegible] instruments and in cases of cystitis.

[illegible] superficial and confined to a few follicles [illegible] their contents into the urethra, or it may [illegible] the entire gland. In the latter case [illegible] be formed. If allowed to progress with- [illegible] discharged into the urethra, rectum, or

[illegible] comes on suddenly and is manifest by [illegible] the perineum with frequent, painful and [illegible] tenesmus. There is a feeling of fullness as if [illegible] the rectum with straining at stool, high fever [illegible] upon the perineum gives pain.

[illegible] upon the presence of the causative factors, [illegible] rectal examination. The examination will dis- [illegible] and inflamed gland, which may show at some [illegible] abscess formation.

[illegible] occurrence of prostatitis all local treatment of [illegible] continued, the patient put to bed upon a restricted [illegible] opened. For pain, rectal suppositories containing [illegible] opium and one-fourth grain of belladonna may [illegible] are serviceable. If the abscess is superficial and [illegible] with good drainage, surgical interference will be [illegible] readily heals. If the abscess opens into the urethra [illegible] and the condition progressive with pain and ten- [illegible] should be drained through the perineum. Perineal [illegible] instituted, if rectal examination shows the gland to [illegible] painful and tender with no abatement of the symp- [illegible] days' treatment. For this purpose the patient is

anæsthetized and put in the lithotomy position with a sound in the bladder. The rectum is washed out. An incision is made in the median line of the perineum and gradually deepened, avoiding the urethra as determined by the sound, and the rectum by the finger, until the prostate is reached, when the abscess is opened. The cavity may then be washed out and a tube introduced and left for four or five days. The cavity is irrigated each day and the tube removed after four or five days and the cavity and tract allowed to close by the formation of granulation tissue.

CHRONIC PROSTATITIS.

This is usually the result of an acute attack or follows the extension backwards of a chronic urethritis.

SYMPTOMS.—There is a sense of weight and heaviness in the perineum, frequent urination, especially at night, often followed by a discharge of mucus. Examination shows the prostate enlarged and tender. The vesiculæ may also be implicated in the inflammation.

TREATMENT.—The diet should be restricted, stimulants interdicted and the bowels regulated. Salol or urotropin may be given internally. Hot sitz-baths are often serviceable and in obstinate cases a few drams of a solution of silver nitrate of the strength of one to eight grains to the ounce may be instilled into the prostatic urethra.

TUBERCULOUS DISEASE OF THE PROSTATE.

This is usually a sequence of a tuberculous lesion of the epididymis or seminal vesicles, although the process may be primary in the prostate. If the prostate becomes affected the lesion is likely to spread to the bladder and from there to the ureters and kidneys. Tuberculous caseous masses are formed which break down and produce ragged ulcers.

SYMPTOMS.—There is pain, frequency of urination, with pus in the urine, *and occasionally hæmaturia*. The diagnosis is established by finding the bacillus of tuberculosis in the urine.

TREATMENT.—The internal treatment should be hygienic with the administration of tonics and possibly guaiacol. If the process is confined to the prostate, seminal vesicles, and epididymis, these structures may be removed.

PROSTATIC CALCULI.

These calculi are small, usually composed of carbonate of lime and situated in the crypts. They are not frequent but when occurring may be secondary to a stricture or gonorrhœal prostatitis.

SYMPTOMS.—If these calculi project above the surface they are likely to produce symptoms of obstruction, while the passage of the sound may produce the grating sensation of a stone.

TREATMENT.—If causing disturbance they may be removed by a perineal incision.

ENLARGEMENT OF THE PROSTATE.

Senile Hypertrophy.—This condition is rare before fifty. After fifty the prostate enlarges in about one-third of the cases. Histologically there is an over-growth of some one or more of the connective tissue structures of the gland. As a rule the enlargement is due to an increase in the fibrous

pand, when the outward current rushing into the bulb will carry with it many of the small fragments and debris of the broken down stone. These fragments and debris fall to the bottom of the glass receiver, where they remain. The bulb is compressed and relaxed successively until no more fragments are washed out. If fragments of stone are still left in the bladder the evacuating catheter is withdrawn and the lithotrite re-introduced and the crushing and washing continued until the bladder is free from fragments. Two or three ounces of warm boric acid solution should be left in the bladder (Fig. 137).

After Treatment.—The patient is kept in bed for a few days, the urine being withdrawn by a soft catheter if necessary and the bladder irrigated. If no complications arise the patient is allowed to get out of bed in two or three days.

The complications which may develop are fever, chills, acute cystitis, orchitis, epididymitis and suppression of the urine. None of these complications, however, may be expected. Death may occur from perforation of the bladder, sepsis, or cystitis.

AFFECTIONS OF THE PROSTATE—ACUTE PROSTATITIS.

This is usually the result of gonorrhœal infection. The inflammatory process extends upwards to the prostatic urethra. It may occur as the result of the passage of unclean instruments and in cases of cystitis.

COURSE.—The process may be superficial and confined to a few follicles which suppurate and discharge their contents into the urethra, or it may be deep-seated and implicate a lobe or the entire gland. In the latter case an abscess of considerable size may be formed. If allowed to progress without interference, the pus will be discharged into the urethra, rectum, or perineum.

SYMPTOMS.—The inflammation comes on suddenly and is manifest by a severe pain situated deeply in the perineum with frequent, painful and difficult urination, followed by tenesmus. There is a feeling of fullness as if a foreign body was situated in the rectum with straining at stool, high fever and often chills. Deep pressure upon the perineum gives pain.

DIAGNOSIS.—This will rest upon the presence of the causative factors, the symptoms as given and a rectal examination. The examination will disclose an enlarged, very tender and inflamed gland, which may show at some particular area softening and abscess formation.

TREATMENT.—With the occurrence of prostatitis all local treatment of the urethra should be discontinued, the patient put to bed upon a restricted diet and the bowels freely opened. For pain, rectal suppositories containing one-half grain of extract of opium and one-fourth grain of belladonna may be used. Hot sitz-baths are serviceable. If the abscess is superficial and opens into the urethra, with good drainage, surgical interference will be unnecessary, as the cavity readily heals. If the abscess opens into the urethra and drainage is imperfect, and the condition progressive with pain and tenderness, the cavity should be drained through the perineum. Perineal drainage should also be instituted, if rectal examination shows the gland to be much enlarged, very painful and tender with no abatement of the symptoms after two or three days' treatment. For this purpose the patient is

anæsthetized and put in the lithotomy position with a sound in the bladder. The rectum is washed out. An incision is made in the median line of the perineum and gradually deepened, avoiding the urethra as determined by the sound, and the rectum by the finger, until the prostate is reached, when the abscess is opened. The cavity may then be washed out and a tube introduced and left for four or five days. The cavity is irrigated each day and the tube removed after four or five days and the cavity and tract allowed to close by the formation of granulation tissue.

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and muscular tissues, but it may be due to a growth of the glandular structure, or of all three of these tissues combined. The gland often reaches a very considerable size, perhaps as large as a man's fist. The causes of this over-growth, excepting the influence of age, are not well understood. It has been held that it was due to sexual excess, gonorrhœal infection, or some form of chronic inflammation. The gland may be symmetrical or asymmetrically enlarged. In some cases that part of the gland situated between the ejaculatory ducts and the base of the bladder is especially enlarged, constituting what is known as the third lobe. In consequence of the enlargement the urethra is pushed forward, and may be elongated from one to three inches. Urination is difficult and the bladder cannot be entirely emptied. Infection occurs, followed by cystitis and decomposition of the retained urine. The infection may come from unclean instruments, through the blood current, from the kidneys or rectum.

SYMPTOMS.—These usually come on gradually. The patient at first is compelled to rise once or twice during the night for the purpose of emptying his bladder. Infection is likely to occur, followed by all the symptoms of acute cystitis. A severe cold may bring on complete retention. The cystitis may be acute or subacute, in either case it is attended with frequency and pain in urinating with an alkaline, phosphatic and pus-laden urine and often with slight fever. If infection of the bladder is acute, and the conditions perhaps follow retention of urine, there is likely to be high fever with chills, great pain, almost constant desire to urinate and profuse perspiration. The patient may become exhausted as the result of septic intoxication.

DIAGNOSIS.—This is made by considering the age of the patient, the symptoms, and the result of the rectal examination. The examination is conveniently made if the patient is on his back and his knees drawn up. The anointed finger is introduced into the rectum with the palmar surface forwards. A couple of inches above the sphincter and toward the bladder, a large, smooth, hard, rounded and double-lobed enlargement is encountered. The gland is slightly tender to the touch and although considerably enlarged the finger can be readily swept around the lobes and often passed above it defining its upper limits. An enlargement of the third lobe may cause obstruction, while the lateral lobes remain practically normal in size. The amount of residual urine is determined by having the patient pass his water after which the catheter is introduced, the urine drawn off and measured. The information of importance is the frequency of urination, especially at night, the length of the urethra, the amount of residual urine, the age of the patient and the results of a rectal examination.

TREATMENT.—The patient is confined to a restricted diet, should avoid alcohol and sexual excesses and keep his bowels open. The greatest care should be exercised in order to prevent infection and for this purpose salol or urotropin may be administered. If it is found necessary to catheterize the patient, great care must be exercised so as to avoid infecting the bladder. If the patient is suffering from cystitis with residual urine, the condition not being controlled by internal medication and irrigation of the bladder, and if he is unable to void his urine without the aid of a catheter operative measures should be undertaken. If the patient is under sixty years of age the Bottini operation should be done.

The Bottini instrument (Fig. 138) is in appearance not unlike a lithotrite, the male blade has a movable cautery knife with a short beak which is connected with a storage battery. A suitable battery is placed upon the market of four volts and sixty amperes. In practising the operation, general or local anæthesia may be used. When local anæsthesia is resorted to, the bladder is well washed out and emptied. Then one ounce of a ten per cent. solution of eucain is injected into the bladder and allowed to remain there for five minutes. Following this from six to eight ounces of boric acid solution is injected. The Bottini instrument, after thorough sterilization, is introduced into the bladder and its beak turned backwards and hook-

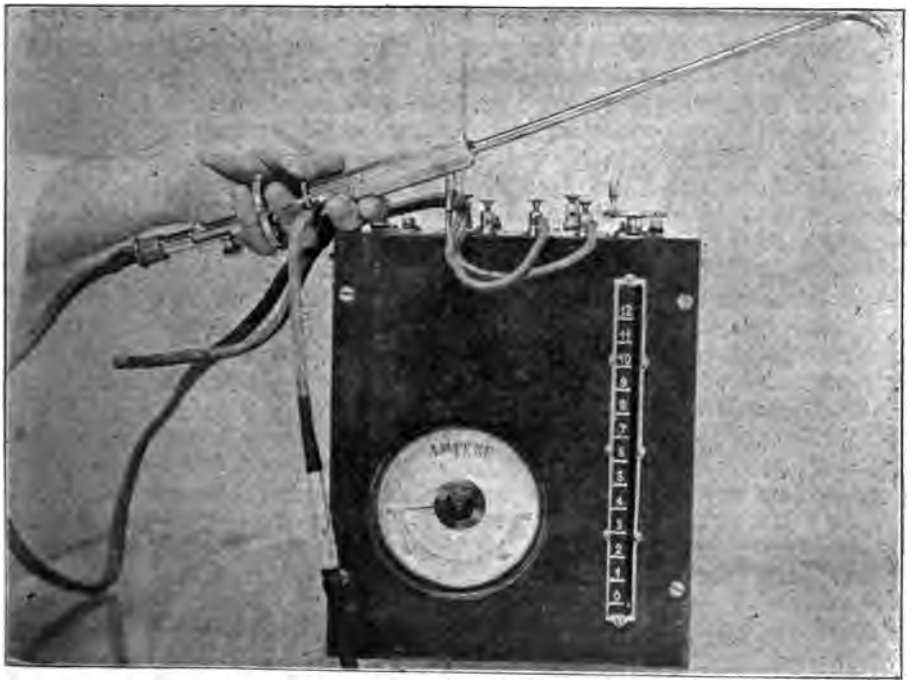

Fig. 138.

ed over the prostate. A finger in the rectum should define the position of the beak, so that no injury is done to the rectum, and also to estimate the length of the prostate from behind forwards. With the instrument pressed firmly against the center of the prostate and connected with a storage battery, a sufficient current is turned on to bring the knife to a red heat which ordinarily requires about forty amperes.

The knife is then made to cut its way slowly through three-fourths of the prostate. The current is then turned off and the instrument closed, when it is turned about fifteen degrees to the right and the blade made to cut its way through three-fourths of the left lobe of the prostate. The instrument is again closed and turned to the left and the right lobe of the prostate burned through. The current is now turned off, the instrument closed

and withdrawn. There is usually some hemorrhage following the operation, but it is seldom serious. A large catheter should be introduced and the bladder washed out with a warm carbolized solution. The catheter may be left in the bladder if thought advisable. For two or three days, the bladder should be washed out two or three times each twenty-four hours. There is little pain or soreness following the operation and the patient is usually able to be up on the second or third day.

The advantages of the Bottini operation between the ages of forty-five and sixty are that it does not interfere with the sexual function, can be performed in a few minutes, without a general anæsthetic, is practically without risk and usually meets the indications. The patient is able ordinarily for a number of years to empty his bladder.

After sixty years of age the prostate gland should be removed and this may be done through a perineal incision as follows: After general anesthesia a soft catheter is introduced and the bladder thoroughly washed out, leaving eight or ten ounces of carbolized water within the bladder. With the patient in an exaggerated lithotomy position a hard pillow under the hips, the knees pressed against the abdomen and the perineum properly prepared an incision is made commencing two inches above the rectum and extending downwards in the medium line or to the right about one and one-half inches. Being careful to avoid the rectum the incision is deepened until the membranous portion of the urethra is reached, which is opened. The prostatic urethra is then dilated with the finger or a uterine dilator or incised. The forefinger of the right hand is then passed into the bladder, the mucous membrane over a lateral lobe is torn with the finger nail and the lobe enucleated. The process is repeated upon the other side and if the third lobe is enlarged, this is also removed. A drainage tube is introduced and the bladder washed out. The tube is retained within the bladder for three or four days and then removed and the patient encouraged to be up.

In this operation, the entire work is done by the sense of touch. If thought best to work by sense of sight a large V-shaped incision is turned down from the perineum. The incision is gradually deepened, being careful not to injure the urethra or rectum. When the prostate is reached, lateral incisions are made and the lobes enucleated. The hemorrhage in this operation is often considerable but it is seldom alarming. An accident which may occur, if one is not very careful, is injury to the rectum. It may accidentally be incised or the adhesion may give way suddenly and one's finger enter the rectum. If this accident occurs an effort should be made to close the wound by cat-gut sutures.

In supra-pubic prostatectomies the incision, of course, is made above the pubis. Pressure upon the perineum or in the rectum lifts the prostate toward the surface of the wound. With a finger in the bladder the prostate is outlined and the mucous membrane over one lobe incised with scissors. This lobe is then enucleated and the same process repeated on the other side; the third lobe being removed, if it is enlarged.

The after-treatment in these operations consists in keeping the wound clean, nourishing the patient and getting him upon his feet and out of doors as soon as possible. Aside from the seriousness of a prostatectomy in consequence of the age of the patient, the cystitis and possibly a disease

condition of the kidneys, it is most satisfactory. For a considerable time following the healing of the wound, a sound should occasionally be passed into the bladder to prevent the formation of a stricture. The bladder should also be washed out for a time as the cystitis is seldom entirely cured by the operation. A fistulous tract, although remaining in some cases for a month or more, is seldom permanent and incontinence of urine almost never occurs.

CANCER OF THE PROSTATE.

About ten per cent. of all cases of enlarged prostate occurring in old men are complicated by malignancy. The process occurs in the glandular tissue, is slowly progressive and finally invades the capsule and neighboring structures.

SYMPTOMS.—The symptoms are primarily those of an enlarged prostate. To these is added a degree of pain which is unusual in uncomplicated cases. The patient loses strength and flesh and has a feeling of heaviness and fullness in the perineum and rectum. On an examination per rectum the prostate is found enlarged, hard, and quite fixed. In cases which have progressed for a considerable time, the limits of the gland are not well defined.

DIAGNOSIS.—Although this cannot be positive without a microscopical section, the frequency of the disease is such and the importance of early removal so great that the surgeon should base his treatment on the clinical findings. The symptoms of importance are the severe pain which may be quite distinct from that of cystitis, the hardness, tenderness, and fixity of the gland.

TREATMENT.—If any treatment is going to be of avail in cancer of the prostate it must be thorough. The gland should be thoroughly excised. Young recommends that the membranous portion of the urethra be divided and the gland and neck of the bladder excised. The neck of the bladder is then narrowed and connected by sutures to the urethra, and the wound drained.

AFFECTIONS OF THE URETHRA AND PENIS—CONGENITAL MALFORMATIONS.

Occasionally there is a total absence or occlusion of the urethra with an accumulation of the urine in the bladder, ureters, and kidneys. This condition tends rapidly to a fatal termination. In a few cases the urachus remains open and a congenital urinary fistula is established or a cloacal condition may persist and the urine be discharged into the rectum.

EPISPADIAS.

By this is understood a deformity in which the urethra is partially or wholly exposed along its upper surface. In some instances the external meatus is situated just above the glans, which is cleft. In other cases the urethra opens just in front of the symphysis. Complete epispadias is usually associated with extroversion of the bladder. The incomplete form as been successfully treated by taking flaps from the sides of the penis to fill defect

HYPOSPADIAS.

In this condition there is want of development of the lower wall of the urethra. Three varieties are described.

(a) *Hypospadias glandis.* In this variety the opening of the urethra is along the under side of the gland.

(b) In *hypospadias penis* the opening is somewhere along the under surface of the body of the penis.

(c) In *hypospadias perinei* the lower wall of the penis is absent as far back as the perineum. The penis in the latter condition is bound down by adhesions and not well defined. In extreme conditions the sex of the child is not easily made out as the testicles are undescended.

In the incomplete varieties flaps may be secured from the enlarged prepuce or from the sides of the penis with which to fill in and cover the defect. In the complete variety, the penis must first be freed by dissection and then the skin from the sides of the cleft in the scrotum is dissected up to form the posterior wall of the canal and the walls of the scrotum brought together over this. The anterior portion of the defect is treated as in incomplete cases.

TRAUMATIC LACERATION OF THE URETHRA.

This is usually the result of falling astride of some hard object. It may follow from kicks or from fractures of the pelvis.

SYMPTOMS.—There is pain in the perineum with swelling from extravasation of blood and urine and bleeding from the meatus. If an attempt is made to urinate, this is usually unsuccessful as is also an attempt to pass a catheter.

Extent of Injury.—The traumatism is usually received upon the membranous portion of the urethra. At times the mucous membrane alone is torn or the tear is confined to the posterior wall. In severe cases the entire urethra is torn across.

TREATMENT.—If the mucous membrane alone is ruptured and there is but moderate swelling from the extravasation of blood and the patient can urinate, rest in bed with urinary antiseptics and opening of the bowels may be all that is necessary. If there is considerable hemorrhage in the perineum and an inability to pass urine, perineal section should be made without delay. If the urine becomes extravasated and infection occurs there is likely to be a virulent inflammation. Perineal section for rupture of the urethra is ordinarily a simple operation. After proper preparation a sound is passed, under antiseptic precautions, down as far as the rupture where its point will be arrested. The scrotum is now held forward and an incision made directly on the point of the wound. With the wound well retracted an effort is made to locate the proximal end of the urethra. This usually can be done in consequence of the injury to the tissues, the extravasated blood and the further fact that the anterior wall is often not ruptured. As soon as the proximal end has been found, it is seized with forceps and an English or soft catheter of suitable size carried down the penis and across the rent into the bladder. The catheter is tied to the penis and the wound lightly packed. After one week the catheter may be removed. It is ordinarily not necessary to suture the torn ends of the urethra.

It is of great importance to avoid a fistulous tract and for this purpose thorough antisepsis and the use of the catheter for one or more weeks are usually advisable. After the healing of the wound it will be necessary once a month perhaps for a year to pass a sound to prevent the formation of a stricture.

FOREIGN BODIES IN THE URETHRA.

Pieces of pipe stem, lead pencil and pins are occasionally introduced into the urethra. These foreign substances cause inflammation in the urethra and obstruct the flow of urine. If the foreign substance is hard and near the meatus it may be seized with forceps and extracted, otherwise it should be cut down upon and removed. When a pin is introduced head first and cannot be extracted, it should be seized from behind and its point pushed through the floor of the urethra. This is grasped with forceps. drawn through and the head turned in the opposite direction. The head may now be seized with forceps and extracted.

IMPACTED CALCULUS.

This is likely to cause not only obstruction to the flow of urine but very severe pain. The calculus should be pushed back into the bladder, if practicable, by the use of a sound and then crushed or cut down upon and removed.

SIMPLE URETHRITIS OR NON-GONORRHEAL URETHRITIS.

This may be the result of various causes. Leucorrhœa, in the female. the passage of instruments, or calculi, and urine which is highly acid. The symptoms are much the same as in gonorrhœal urethritis, but the discharge is thinner.

TREATMENT.—The diet should be non-stimulating and the bowels regulated. Internally, salol or urotropin may be given with or without an alkali At the same time rest should be enjoined.

POLYPOID TUMORS.

These may occur in the urethra near the meatus as red, vascular and painful growths. They should be excised and the base cauterized.

EPITHELIOMATA.

An epithelioma may occur within the urethra at the site of a stricture or be the result of extension from an epitheliomatous ulcer of the prostate. The process, however, is very rare.

In its progress it infiltrates the parts causing a hard node, urination is painful and the passage of an instrument somewhat difficult and often followed by bleeding. If the disease can be diagnosed the penis should be removed, if possible, well behind the ulcer.

STRICTURE OF THE URETHRA.

This is a temporary or permanent narrowing of the urethral canal in which normal dilatation is prevented and the discharge of idered.

Strictures may be divided into congenital and acquired. Congenital strictures usually occur at or near the meatus. This condition is rare, but when occurring requires prompt attention by incision in order to prevent over-distention of the bladder, ureters and kidneys.

Acquired Stricture. Three forms have been described. Spasmodic, congestive or inflammatory, and organic.

Spasmodic Stricture. This is a temporary narrowing of the canal due to voluntary or involuntary contraction of the muscles. This contraction may be reflex or psychical in character.

Reflex. This may be excited by the irritation of an inflamed or over-sensitive urethra, by an over-acid and irritating condition of the urine, as in uric acid diathesis and cantharidal poisoning, and in consequence of irritation of the rectum as in fissures, worms, cancer, and following operations on hemorrhoids.

A *psychical* disturbance is usually transitory and may occur as the result of embarrassment in consequence of the presence of strangers or in consequence of haste in an attempt to urinate.

DIAGNOSIS.—This will rest upon the suddenness of the attack and the absence of symptoms of acute inflammation.

TREATMENT.—In spasmodic stricture the bladder must not be allowed to become over-filled. The spasm can usually be relieved by a hot bath, or if this does not succeed a catheter should be passed.

ORGANIC STRICTURE.

This is usually the result of a gonorrhœal urethritis or of a traumatism. Organic stricture occurs in about 12 per cent. of the cases of gonorrhœa and is most frequent between the ages of twenty and forty-five. It is especially frequent in those cases in which the inflammation has been intense and long continued. An organic stricture seldom becomes manifest during the first year following an attack of gonorrhœa. As the result of a traumatism, an organic stricture may produce symptoms of obstruction in a few weeks following the injury.

CLINICAL CLASSIFICATION OF STRICTURES.—*Linear stricture.* This is one in which the contracted area is very limited, or cord-like. Annular or ribbon stricture is one in which the contraction is like a band or ribbon.

Tortuous Stricture. By this is meant that the canal is crooked, not straight.

Permeable and Impermeable Strictures.—By a permeable stricture is meant a condition in which a catheter or bougie can be passed into the bladder. In an impermeable stricture, neither urine can be voided or an instrument made to pass the stricture.

Irritable Stricture.—This is one in which the passage of an instrument causes severe pain and is followed by hemorrhage and often inflammation.

Resilient Stricture.—This stricture is made up largely of contractile tissue which contracts readily after dilatation.

Soft Stricture.—By this is meant that the sub-epithelial exudate is recent and soft and the canal easily dilated.

Cicatricial Stricture.—This form is characterized by its hardness in consequence of the formation of a mass of fibrous tissue.

Strictures have also been divided into those of large, and those of small caliber. In the former a No. 15 French sound can readily be passed, while in the latter a No. 15 French sound cannot be passed.

LOCATION OF STRICTURE.—The most frequent seat of a gonorrhœal stricture is the bulbo-membranous portion of the urethra. The first two and one-half inches of the urethra is said to be the second most frequent seat, while the middle of the spongy portion of the urethra is least frequently affected. Stricture of the prostatic portion is very rare. It is held that the occasion of the frequency of stricture at these points is, first, their extreme vascularity; second, that these areas are rich in glands; and, third, that the inflammation is likely to continue longer at these points than elsewhere.

PATHOLOGICAL CHANGES.—The epithelial lining shows proliferation and desquamation.

The peri-urethral inflammatory exudate becomes organized into fibrous tissue and as the result of the contraction of this tissue a stricture is produced. In consequence of the increased pressure required in passing the urine the urethra behind the stricture becomes dilated. A few drops of urine remain in the urethra behind the stricture and undergo decomposition. As the result of the increased pressure and the irritation of the decomposing urine, the epithelial lining desquamates and ulcers are formed. The urine infiltrates the deeper strictures and an abscess occurs which often ruptures externally leaving a fistula. The distal portion of the urethra undergoes contraction.

The muscular coat of the bladder hypertrophies, cystitis is usually present and the infection may become an ascending one and reach the kidneys.

SYMPTOMS OF STRICTURE.—One of the first symptoms complained of is difficulty in urinating. The stream is slow in starting, small, and often forked. It takes more force and a longer time to empty the bladder than normally. After micturition a few drops of urine dribble away wetting the patient's clothing. This dribbling is due to the fact that a small amount of urine is retained behind the stricture and escapes by the force of gravity after urination is apparently complete. The bladder is usually irritated or inflamed as the result of the obstruction, the extension backwards of the chronic inflammation and the decomposition of the urine, and consequently micturition is more frequent than normal. As the obstruction becomes greater the amount of residual urine in the bladder is increased until finally a pear-shaped tumor of considerable size may be felt in the hypogastrium. In this condition the incontinence of retention is likely to occur, the urine dribbles away, constantly wetting the patient's clothing and imparting a very unpleasant and urinous odor which is difficult to get rid of. Coincident with the distention of the bladder wall, it becomes thinned and in a state of atony. Complete retention may occur in these cases in consequence of congestion, incident to the taking of a cold or the over-indulgence in alcoholics.

PHYSICAL EXAMINATION.—A positive diagnosis of stricture can only be made by the introduction into the urethra of a sound. A No. 10 or 12 English may first be introduced and if this will not pass smaller sounds or bougies are tried successively until one is found that will pass the stricture.

TREATMENT OF ORGANIC STRICTURE.—Before exploring the urethra with an instrument the parts should be asepticized. The glans penis is washed with a bit of gauze dipped in carbolized water or in alcohol, and the urethra washed out with a carbolized or other antiseptic solution. One or two drachms of a 4 per cent. solution of eucaine is then injected into the urethra and retained there from three to five minutes by compression of the glans. An instrument before being used must be sterilized. Nearly all of the urethral instruments can be boiled for five minutes in a 3 per cent. soda solution. Non-metal instruments, may, if thought best, be sterilized by immersion for twenty-four hours in a formaldehyde solution of full strength.

The treatment of organic stricture may be considered under the following heads:

First, gradual dilatation. Second, divulsion. Third, internal urethrotomy. Fourth, external urethrotomy.

In dilating a stricture one must first find an instrument that can be passed into the bladder. A stricture which will not admit a No. 8 English sound should be dilated by bougies. Small steel instruments produce much greater irritation and injury to the urethra than do soft instruments and their use may cause the formation of false passages. For an almost impermeable stricture one should commence with a No. 1 bougie. The surgeon standing at the left side of the patient grasps the penis behind the glans with the finger and thumb of his left hand and straightens it. The right hand holds the bougie, which has been lubricated with some material such as vaseline or olive oil. Some of the lubricant should also be smeared over the meatus. The bougie is then made to enter the meatus and is pushed gently down to the stricture, where it is likely to become arrested. The instrument is then withdrawn for one-fourth or one-half of an inch, slightly rotated and with the gentlest of force pushed forwards, this manœuver is repeated again and again, rotating the instrument to the right and left, elevating and depressing the penis. Force is never permissible, as there is great liability with its use of producing a false passage. If the surgeon does not readily succeed, the bougie may be withdrawn and a slight curve imparted to its neck. Then the process is repeated. If he is again unsuccessful and is using a No. 1 bougie, this may be changed for a filiform bougie made of whalebone, several of which may be introduced into the urethra, while each in turn is manipulated for the purpose of finding an entrance into the stricture. After inserting two or three filiforms, a No. 1 English bougie may also be introduced and manipulated within the urethra. With care, gentleness, and perseverance, the surgeon is almost certain to succeed. This may not be on the first or even the second day, but success practically always crowns the labor of the patient worker in strictures which are permeable (Fig. 139).

Having passed the bougie into the bladder it is left in position for from fifteen to thirty minutes and then withdrawn and the canal washed out with some antiseptic solution and the patient given, internally, quinine and salol. On the following day the patient returns and the bougie which was previously introduced is again passed into the bladder. This is often readily accomplished. The bougie is allowed to remain in position for from five to ten minutes, or until it is no longer grasped by the stricture, when it is with-

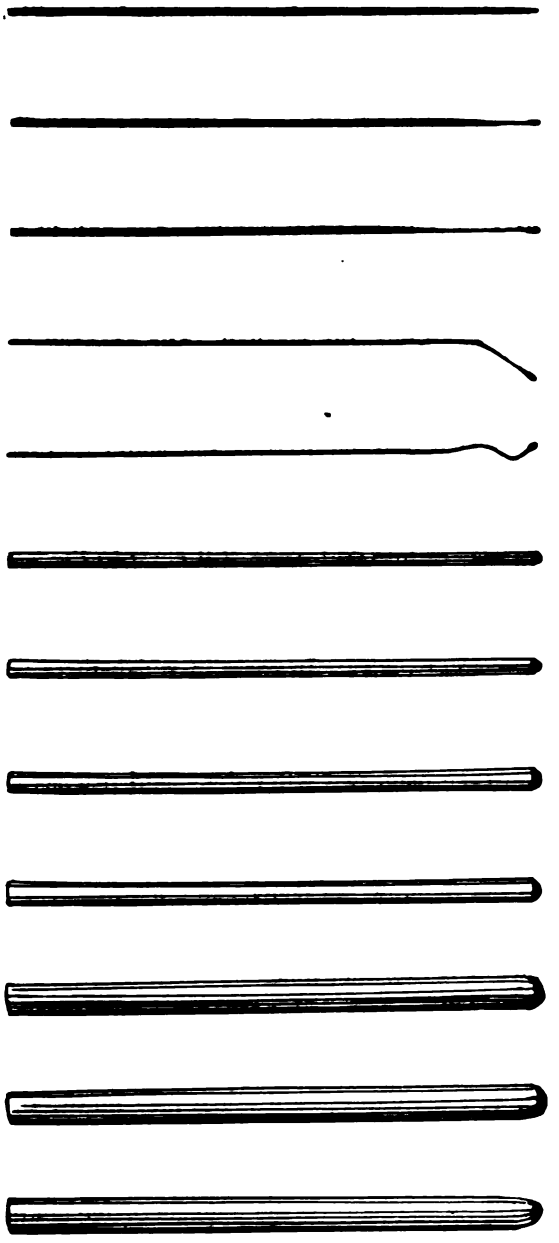

Fig. 139.—Filiform and gum elastic English bougies.

drawn and another a size larger introduced. This is left in position for several minutes and then withdrawn and the urethra washed out. The patient is dismissed, to return upon the following day. With each succeeding day a bougie one size larger than used on the previous day can usually be intro-

duced. Occasionally on account of the hyperæmia, swelling and pain, the surgeon has to go back a size or two and gradually work his way up to the size previously employed. When a No. 7 or 8 bougie can be introduced, the dilatation thereafter may be carried on with steel sounds, and these rapidly carried up to No. 14 or 15, English. Following this and in order to prevent subsequent contraction a sound should occasionally be passed during several months.

The Technic of Passing a Steel Sound. The patient should be recumbent and the parts cleansed. The canal may be irrigated with 1 to 20,000 bichloride solution, or 1 to 10,000 permanganate, or a weak carbolic acid solution. The sound is sterilized by boiling or by dipping in alcohol up to the handle and then igniting the alcohol. The surgeon stands at the left side of his patient and with the foreskin retracted, grasps the penis behind the glans with the finger and thumb of the left hand and straightens it out toward the left groin and close to the abdominal wall. A drachm of olive oil may then be injected into the urethra, the sound well lubricated is taken in the right hand and its tip made to enter the meatus. The sound is kept close to the abdomen and on a line with the left groin, while in this position it is pushed gently along the urethra for three or four inches when the shaft is carried to the median line and while still close to the abdomen is pushed forward until its passage is hindered by the triangular ligament. The sound is then gradually raised to the perpendicular and as it passes the triangular ligament the handle is depressed quite rapidly to the horizontal as the sound enters the bladder. In cases in which there is no considerable obstruction, this manœuver is conducted with one sweep of the hand. If the sound is raised at the triangular ligament too soon and it becomes arrested it may be withdrawn slightly while the handle is further depressed as it is pushed on into the bladder. After the sound reaches the perpendicular the fingers of the left hand may make pressure on the perineum over which, as a fulcrum, the sound is carried into the bladder. After the handle has passed the perpendicular, the fingers of the right hand may make pressure on either side of the roots of the penis.

The entrance of the sound into the bladder is recognized by the free mobility of the tip when the handle is rotated, and by the further fact that the sound remains in the median line.

After each sounding the urethra should be irrigated with some mild antiseptic.

During the passage of the sound spasm of the circular muscular fibres of the urethra or of the compressor urethræ may hinder the passage of the instrument for a minute or two. Gentle but steady pressure will soon overcome this obstruction. If the sound is raised too soon, its tip will catch against the sub-pubic ligament, but if the handle is not raised soon enough the point will catch on the floor of the bulbous or membranous urethra and its onward course arrested.

The introduction of the sound should be carried on with the greatest gentleness, it entering the bladder almost by its own weight. When one is dilating a dense stricture and has become perfectly familiar with its situation and direction, considerable force may be used, if the sound is a large one.

In cases of stricture there is usually some bleeding after the passage of a sound which has quite forcibly dilated the canal. This may continue from twenty-four to thirty-six hours, or the discharge may be sero-purulent. There is also an active hyperæmia with frequency of micturition and pain. As the result of the hyperæmia the fibrous tissue of the stricture softens and is gradually absorbed. If the patient is not pressed for time this active hyperæmia, which follows the introduction of the sound, should be allowed to partially subside before the treatment is resumed.

Complications. With proper antisepsis and gentleness complications are not likely to arise. False passages may be caused, however, by want of skill or as the result of undue force. A false passage may be followed by the formation of an abscess or by extravasation of urine. If either of these conditions occur, free incision will be necessary for the purpose of giving vent to the pus or urine, and affording free drainage. As the result of infection, epididymitis or cystitis may develop or the infection may even reach the kidneys through the ureters.

DIVULSION OF THE STRICTURE.—By this is understood the forcible rupture of the stricture by mechanical means. Various instruments have been employed for this purpose. One of these consists of a slender staff over which sliding tubes of increased size are passed. One is in the form of a wedge which is driven through the stricture. The instrument most commonly used consists of two or more small shafts which are separated by a strong screw. The instrument is introduced through the stricture while closed and then forcibly opened by the screw, divulsing the stricture. This operation at the present time is seldom practised in this country. It has all of the dangers and practically none of the advantages of incision.

INTERNAL URETHROTOMY.—In this operation the stricture is divided with a knife. (a) This may be from before backwards; (b) or from behind forwards; (c) or through the roof; (d) or the floor of the urethra.

STRICTURE OF THE MEATUS.—The meatus is quite frequently the seat of a stricture. The condition may be acquired as the result of a balanitis, an internal urethritis or it may be congenital. A stricture situated at the end of the meatus is extremely sensitive and prevents the passage of large sounds. Dilatation is not practicable. A stricture in the navicular portion of the urethra, after being properly cleansed, should be divided by a tenotome usually through the roof of the canal. A stricture situated at the meatus is divided with a bistoury from within forwards through the floor of the canal. The incision should include about one-fourth of an inch of the extremity of the urethra. Following the incision the mucous membrane upon the right and left sides of the incision, respectively, are united over the cut surface by one or two fine silk sutures.

INTERNAL URETHROTOMY.—*Indications for operation.* Resilient and irritable strictures, and those which cannot readily be dilated, are considered suitable for incision, provided they are situated anterior to the bulb of the urethra.

PREPARATORY TREATMENT.—The patient should be confined to the bed for two or three days and given urinary antiseptics such as quinine, salol or urotropin. The bladder and urethra should be washed out night and morning and also just before the operation. The instrument most commonly used

is the Maisonneuve urethrotome (Fig. 140). With the instrument there is a filiform bougie which is passed into the bladder and then secured to the tip of the urethrotome. The shaft of the instrument is then passed through the stricture and the knife forced down, the shaft cutting the stricture. The instrument is then withdrawn and a full-sized catheter introduced. The patient should be kept in bed for two or three days, when, if there is no special systemic disturbance such as chills or fever, he may be allowed to get up. The canal is subsequently kept open by the occasional passage of a sound. Supplementary to this operation, or as an original one, the stricture may be divided from behind forwards. The division is then made through the roof to the canal.

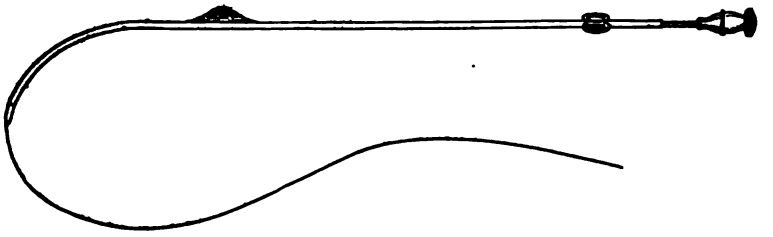

Fig. 140.—Maissoneuve's urethrotome.

External Perineal Urethrotomy with a Guide.—This operation is done for the following conditions:

(a) A stricture behind the bulbo-membranous junction which cannot readily be dilated.

(b) A stricture behind which extravasation of urine has occurred.

(c) A stricture complicated with a perineal abscess, the fistula of which does not close with full dilatation.

(d) A stricture coupled with intense cystitis, requiring drainage.

(e) A non-dilatable stricture associated with enlarged prostate.

(f) A stricture coupled with retention of urine or incontinuence of urine.

The operation is done as follows: A filiform bougie is passed into the bladder as a guide, then with the patient in the lithotomy position, with the rectum well scrubbed out and the perineum properly prepared, an incision is made, commencing two inches in front of the rectum and extending downwards in the median line for an inch and one-half. The incision is gradually deepened until the bougie is reached, when the knife is carried along its border through the stricture. If a fistulous tract is present this should be opened into the incision. If extravasation of urine has occurred other incisions may be necessary. A full-sized catheter is then introduced into the bladder. If cystitis is present frequent irrigation of the bladder will be necessary. The catheter should be removed every two or three days and the urethra flushed with an antiseptic solution, when a new catheter is introduced. The catheterization is usually continued for from one to three weeks.

External Perineal Urethrotomy without a Guide.—This operation is indicated in all cases in which the stricture is impermeable, which condition not infrequently follows a traumatism.

The technic is as follows: A sound is passed down to the stricture, which is usually in the membranous portion of the urethra. An incision two or three inches in length is then made in the median line or extending into the ischio-rectal fossa. The incision is gradually deepened down to the point of the sound. The wound must be reasonably long, quite free from blood, its edges well retracted and in a good light. At the point of the sound, and at the bottom of the wound, a thin line of granulation tissue or a smooth fibrous strand will usually denote the site of the strictured canal. A fine probe can usually be passed through the stricture and upon this the stricture is divided. If the stricture is not readily located, compression of the over-distended bladder is likely to force a few drops of urine out of the bladder revealing the situation of the stricture. After reaching the tip of the sound the exact location of the stricture should be determined if possible before any further dissection is made, otherwise, one may wander hopelessly about in the tissues of the perineum without finding the urethral canal. After the stricture is located it is freely divided and a large-sized catheter introduced into the bladder.

RETROGRADE CATHETERIZATION.—In cases in which it has been impossible to locate the exact site of the stricture, a supra-pubic cystotomy and retrograde catheterization are indicated. An opening is made in the bladder just above the symphysis, the finger introduced and the internal orifice of the prostatic urethra located. The tip of a sound is then passed into this opening and through the prostatic urethra and made to project into the perineal wound where it is cut down upon and the stricture freely divided. The fenestrated end of a large soft catheter is then removed and the catheter secured to the projecting end of the sound which as it is withdrawn brings the catheter into the bladder. The sound is then passed through the urethra into the wound and the other end of the catheter secured to the sound and drawn through the urethra. The catheter is left in position for a week or more. The wound is packed with iodoform gauze.

URETHRAL FEVER OR CATHETER FEVER.

This is the result of the absorption of bacteria or other poisonous products from a hyperæmic and abraded urethral mucous membrane. The process, when occurring, usually follows the passage of a sound, or some instrument, through a stricture in consequence of which the surfaces are abraded and septic absorption favored. Guyon classifies urethral fever into the chronic and acute forms.

Acute Urethral Fever with a Single Paroxysm. In this form there is a severe chill, high fever, and profuse sweating. During the height of the attack the patient suffers severe pain in the head and neck, dyspnœa, nausea, and vomiting. In other cases the chill is very severe and prolonged, there is vomiting, the urinary secretion is arrested and the patient goes into a state of collapse and dies in twenty-four hours of uræmia or violent septic poisoning.

Acute Urethral Fever with Recurrent Paroxysms. In this form there are recurrent chills followed by sweating and fever. The temperature does not reach normal, while the chills recur several times each day or every few days. The heart action is rapid, the breathing oppressed and the prostration

pronounced. In favorable cases in which the focus of infection can be drained there is likely to be improvement in a few days and the patient gradually recovers. In less favorable cases, septicæmia or pyæmia may occur and terminate fatally.

Chronic Urethral Fever. This form may follow either of the preceding or develop insidiously as a primary affection. Retention of urine followed by cystitis and infection of the kidneys are often predisposing factors. The exciting cause is usually an infection which follows the passage of a sound.

SYMPTOMS.—These are septic and uræmic, recurring chills, fever, profuse perspiration, dry tongue, headache, vomiting, and diarrhœa. There is also rapid loss of strength and stupor. This condition may last for days or weeks and then suddenly terminate fatally upon the mechanical interference of the bladder or urethra.

PROGNOSIS.—Urethral fever when there has been but a single paroxysm of moderate severity is usually readily recovered from. Cases in which there are severe and prolonged chills, rapid pulse, great prostration and anuria are likely to end fatally. Chronic urethral fever in old and debilitated people is apt to end fatally, especially after operative interference.

TREATMENT.—*Prophylaxis.* Rigid antisepsis of the urethra and bladder will usually be found of avail if combined with urinary antiseptics. The milder forms of infection only require rest in bed, a vigorous opening of the bowels, careful diet and the administration of salol, urotropin or quinine. Cases of severe infection, in which the secretion of urine is interfered with, should be treated by dry-cups and hot poultices to the loins, vapor baths, infusions of normal salt solution, and digitalis. If septic absorption is progressive, perineal drainage should be practised.

FISTULA OF THE URETHRA.

An abnormal opening through which the urine escapes from the canal into the rectum or externally through the perineum or penile portion of the penis.

URETHRO-RECTAL FISTULA.

The acquired form may be secondary to operations upon the prostate, during which the rectum is accidentally injured. It may also be due to cancer or tuberculosis of the prostate making its way into the rectum, or the fistula may be the result of the extension of a prostatic abscess.

SYMPTOMS.—The important symptoms are the passage of urine into the rectum and the escape of gas and possibly fecal matter through urethra. But a small part of the urine may pass into the rectum and but a tinge of fecal matter may escape through the urethra, or practically the entire contents of the bowels may so escape.

DIAGNOSIS.—This will depend upon the above symptoms. The lesion may be differentiated from a vesico-rectal fistula by the facts that the discharge of urine only occurs intermittently, that is, with micturition; that the urine as it comes from the bladder is not contaminated with feces; and the further fact that the urine can be retained almost as long as in the normal condition.

TREATMENT.—In tubercular and cancerous cases surgical intervention is ordinarily of no avail. In cases due to pyogenic infection of the prostate, mechanical obstruction should be treated by dilating the stricture and in maintaining the parts in an aseptic condition. Continuous catheterization may be practised for some weeks while the bowels are kept open and the rectum cleansed by frequent irrigations. The rectal sphincter should also be paralyzed by mechanical dilatation. If these measures do not succeed a transverse incision may be made in the perineum between the urethra and rectum bisecting the fistulous tract. The openings in the urethra and rectum after being thoroughly freshened may be closed with chromicized cat-gut sutures and the wound lightly packed with iodoform gauze, or a large catheter may be introduced through the urethra into the wound and from there into the bladder where it is retained and the wound packed with iodoform gauze. Great care should be taken in these cases to keep the wounds in the urethra and rectum in a healthy condition.

URETHRO-PERINEO-SCROTAL FISTULA.

This is by far the most frequent form of fistula. It may be due to an ulceration behind a stricture, to traumatism, acute abscess, to a calculus or foreign body in the urethra. The urethral opening is usually single while there may be several openings in the perineum or scrotum.

The external opening may be in the perineum, scrotum, buttocks, thighs, or lateral wall of the abdomen.

DIAGNOSIS.—Will depend upon the fact that pus and urine escape from the openings.

TREATMENT.—In traumatic cases with rupture of the urethra, prompt external incision with constant catheterization and with proper treatment of the wound will usually prevent the formation of a fistula. The early cure of a stricture will prevent the formation of a fistula in this class of cases. For the cure of fistulæ, the urethra must first be restored to its normal caliber, the fistula drained and kept clean and, if necessary, constant catheterization practised. Many of the fistulæ will heal under this treatment. If these measures do not succeed external perineal urethrotomy should be done and the fistulous tract opened into the incision. Constant catheterization for some weeks is then practised and the wound irrigated and packed with iodoform gauze.

URETHRO-PENILE FISTULA.

This is usually a short, straight canal, situated behind a stricture.

TREATMENT.—The stricture should be dilated and the bladder evacuated by a catheter for from one to three weeks. If this treatment is not successful, then after thoroughly aseptisizing the canal the fistula should be excised by elliptical incisions and the borders united with interrupted cat-gut sutures.

PERIURETHRAL ABSCESS.

This condition is due either to a limited extravasation of urine or to the absorption of septic material from an ulcerating surface in the urethra. It is characterized by the formation of a hard, painful swelling in the perineum or scrotum, with fever and chills. The swelling progresses,

softens in the center, fluctuates, and ruptures giving rise in the majority of cases to a perineal fistula.

TREATMENT.—The treatment consists in early incision. If there is a stricture of the urethra this should be divided at the same time that the external incision is made. A full-sized catheter is introduced and the wound packed with iodoform gauze.

EXTRAVASATION OF URINE.

This is due either to a progressive ulceration behind a stricture, or to traumatism. A solution of continuity occurs on the floor of the urethra, usually in the membranous portion, allowing the urine to escape into the perineum, scrotum, penis, or abdominal wall. The attachments of the superficial perineal fascia, laterally to the rami of the pubes and ischium, and posteriorly behind the transverse perinei muscles to the deep perineal fascia, limits the extravasation of the urine in rupture of the urethra to the above mentioned areas.

SYMPTOMS.—The extravasation of urine, if septic, causes fever, chills, swelling, necrosis of tissue, prostration, and even death from septic absorption.

TREATMENT.—The vitality of the tissues and the health of the patient depend upon early and free incision. Every part that is infiltrated must be freely opened, the perineum and scrotum in the median line, the penis, if infiltrated, on each side of the urethra and upon the dorsum. Incisions in the abdominal wall are seldom necessary, although if this area is infiltrated it should be incised. Following the incisions in the perineum a full-sized catheter is introduced into the bladder and the wound treated by the application of hot antiseptic compresses. Quinine and salol should be given internally.

PHIMOSIS.

This is usually a congenital condition, although it may be acquired as the result of the contraction incident to the healing of a preputial ulcer. In well marked cases the skin of the prepuce hangs over the gland as a loose fold. The preputial opening is often only a pinhole in size and consequently retraction is impossible. The mucous membrane of the prepuce becomes adherent to the glans causing retention of the smegma behind the corona glandis. The smegma decomposes and causes irritation and the child pulls at the prepuce to get relief. The condition is often the cause of severe nervous symtoms. Urination is difficult, often painful and incomplete. The bladder may become overdistended.

Phimosis prevents proper cleanliness, favors in after-life the contraction of venereal diseases and aggravates their course.

TREATMENT.—The only treatment worth considering is circumcision. This is practised as follows: The redundant foreskin is grasped close to the gland by the thumb and forefinger of the left hand and drawn upon so that one-half of the skin which covers the gland may be removed. A pair of suitable forceps is now made to grasp the foreskin just in front of the tip of the glans, when the foreskin is removed with knife or shears. The forceps is then removed and any vessels that spurt are ligated. The mucous membrane of the prepuce is split upon its dorsal surface to the corona. The

flaps of mucous membrane are now thoroughly separated from the glans by the fingers, the glans cleansed of smegma, and the flaps removed with shears to within one-eighth of an inch of the corona. The edges of the skin and mucous membrane are now united by a continuous cat-gut suture. The cut surfaces of mucous membrane at the frænum for about one-fourth of an inch should not be included in this continuous transverse stitch, but should be united longitudinally by two separate stitches. A wisp of absorbent cotton is then wrapped two or three times around the organ, covering the suture line. The cotton becomes more or less saturated with blood, gives excellent protection and need not be changed for several days. Three or four times each day, however, a little carbolized water may be allowed to trickle over the cotton. The over-sensitive and now exposed glans may be protected from the irritation of the clothing by placing over it a bit of absorbent cotton or gauze.

PARAPHIMOSIS.

When a narrow prepuce is forcibly retracted over the glans, the patient often finds it impossible to replace it. This is due to the narrow orifice of the prepuce getting behind the corona and to swelling and œdema of the glans. The constriction may be so great as to cause sloughing of the tissues.

TREATMENT.—This consists in pushing the glans back through the prepuce. This can ordinarily be accomplished by encircling the penis with the thumb and finger of the left hand and making extension upon the foreskin while the tips of the thumb, first and second finger of the right hand make pressure upon the glans forcing out the accumulated fluids. When this is accomplished the glans become much smaller and is ordinarily readily forced back through the preputial orifice. If reduction cannot be readily accomplished the narrow restricted rim of the prepuce should be divided on its dorsal aspect. Then reduction is readily effected.

HERPES.

This eruption not unfrequently occurs upon the glans penis. It probably has its origin in local irritation coupled with a lowered state of vitality, especially of the nervous system. The lesion is represented by a group of small vesicles upon a hyperæmic mucous membrane. The vesicles soon break down leaving small ulcers. The condition ordinarily yields readily to treatment, it may, however, be quite obstinate.

TREATMENT.—The parts should be kept thoroughly clean and free from irritation. They may be gently irrigated two or three times a day with a mild antiseptic solution and then covered with zinc ointment containing a small amount of opium. Internally tonics should be given.

WARTS.

These lesions occur upon the penis as pedunculated outgrowths. They may be yellow in color, quite firm and non-sensitive; or vascular and quite painful. They are usually the result of some local irritation. They should be removed with shears close down to the mucous membrane and their base cauterized.

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DIAGNOSIS.—This is made by considering the rapid progress of the growth, the destruction of tissue by ulceration, the marked induration of the base of the growth or ulcer, and the possible cause.

TREATMENT.—When the glans or prepuce are alone involved amputation should be done through the body of the organ.

Technic. The ulcerating surface is well covered with gauze. The penis is extended by an assistant taking hold of its extremity and the skin slightly retracted by the finger and thumb of the left hand placed near the pubis. the organ is then divided by a perpendicular incision well behind the diseased tissue. The mucous membrane of the urethra is then separated for about one-fourth of an inch and split laterally. The folds of the skin are now brought down over the stump in front and behind and sutured to the mucous membrane of the urethra.

Another method of operating is as follows: A flap of skin is reflected from the dorsum, one-half to three-fourths of an inch in length and in width, reaching well down the sides of the penis. At the base of this flap the corpora cavernosa are cut through perpendicularly, while the urethra and spongy portion are divided somewhat lower down. The bleeding is now arrested and the urethra separated for one-fourth of an inch and brought through a slit in the skin flap, which is brought down over the stump and fastened by stitches. The urethra is secured to the margins of the slit by a few stitches. If the inguinal glands are enlarged, they should be removed. When the body of the organ is implicated the entire penis should be removed.

Technic for the Removal of the Entire Penis. The patient is placed in the lithotomy position, the perineum cleansed and an incision made in the median line. The corpus spongiosum is traced backwards and divided at such a point as to allow its proximal end to be stitched in the posterior part of the wound. The corpora cavernosa are separated from their connections to the ischio-pubic rami and an elliptical incision made around the root of the penis. The dorsal artery is secured, the suspensory ligaments divided and the penis drawn forward and removed. The wound is partially closed by suture and drained. The results are quite satisfactory.

AFFECTIONS OF THE TESTES.

There may be a congenital failure of descent of one or both organs. If both are retained within the abdomen the condition is known as cryptorchidism. The testicle may remain in the abdomen near the internal inguinal ring or descend into the canal or reach the region between the external ring and the scrotum. The testicle may also be displaced into the perineum or on the thigh. A testicle that does not descend into the scrotum, remains undeveloped, is subject to frequent injuries and is often the site of malignant change.

The causes of the non-descent of the testicles are said to be abnormal attachments of the gubernaculum testes, peritoneal adhesions and contraction of the inguinal ring.

TREATMENT.—An operation for replacement of a testicle should be undertaken before puberty, for the reason that the testicle does not develop in its abnormal position, the patient becomes nervous and depressed in consequence of the non-descent, and for the further reason that malignancy,

EPITHELIOMA OF THE PENIS.

This condition is seemingly predisposed to by the irritation incident to an adherent foreskin. It attacks most frequently the glans, and the sulcus behind the corona glandis. There is primarily a proliferation of the epithelium of the mucous membrane producing an excrescence or wart-like

Epithelioma of the penis with ulcerative destruction of the glans.

Fig. 141.—A hard, stone-like epithelioma of the glans penis, with phimosis

growth. This growth quite rapidly increases in size, but soon ulcerates and gives off a very offensive, sero-purulent discharge. The ulceration is progressive so that in a few months the major portion of the glans may be destroyed (Fig. 141).

DIAGNOSIS.—This is made by considering the rapid progress of the growth, the destruction of tissue by ulceration, the marked induration of the base of the growth or ulcer, and the possible cause.

TREATMENT.—When the glans or prepuce are alone involved amputation should be done through the body of the organ.

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as above stated, is apt to occur in an undescended testicle. In the treatment an incision is made exposing the testicle by opening the canal, and if necessary the internal ring. In order to accomplish the replacement of the testicle into the scrotum, all of its peritoneal attachments must be divided as pointed out by Bevan. If the testicle is still hindered in its descent, all of the strictures of the cord excepting the vas and its vessels should be doubly ligated with cat-gut and divided. The testicle can then be brought down and placed in an opening tunneled in the scrotum with the finger and secured at the bottom of the opening by a purse-string of cat-gut. The inguinal canal and external ring are then closed as in the operation for the radical cure of hernia. If the testicle is misplaced in the perineum or thigh, and is causing distress, it may be exposed by incision and possibly replaced in the scrotum or removed.

HEMATOCELE OF THE TUNICA VAGINALIS.

This may be the result of a traumatism, follow tapping or occur without apparent exciting cause.

SYMPTOMS AND COURSE.—The patient is usually seized with a sudden, sickening pain in one side of the scrotum which becomes filled with blood. The tumor fluctuates and is tense and tender on handling. Fluctuation may in a few days disappear, in consequence of the coagulation of the blood. If the condition is left to itself the blood may gradually be absorbed or in part become organized, or as the result of infection, suppuration may occur.

TREATMENT.—The scrotum should be supported under compression. If the bleeding is still going on an incision should be made, the clots turned out and the bleeding vessel secured. If after two or three years absorption does not occur, or if the clot becomes infected, free incision should be practised, the clots turned out and the sac drained.

HEMATOCELE OF THE CORD.

This may occur as the result of an injury or strain or without apparent cause. In consequence of the rupture of a vessel and the escape of blood in the cord a tumor, extending from the external inguinal canal to the scrotum, is produced. The tunica vaginalis is not affected. The condition must not be mistaken for hernia on account of its sudden onset and pain. It may be differentiated from hernia in consequence of the rings and canal remaining free, the absence of impulse, the presence of fluctuation and the ecchymosed condition of the skin.

TREATMENT.—The part should be supported under compression. If there is still bleeding an incision should be made, the clots turned out, the bleeding vessel secured and the wound drained. If the clot is not absorbed, or if infection occurs, an incision should be made and the wound drained.

INFLAMMATION OF THE TESTIS.

These processes are chiefly confined to the testicle (orchitis) or epididymis (epididymitis). They may be acute or chronic.

ACUTE ORCHITIS.

This process may complicate mumps, gonorrhea, or any of the infectious diseases. It may also be the result of an injury.

SYMPTOMS AND COURSE.—The inflammation is ushered in suddenly with severe pain, followed by swelling and fever. The pain is of a sickening character and extends up the cord. The skin over the testicle becomes red, infiltrated and œdematous. There is usually a serous effusion into the tunica vaginalis. After a period of one week or ten days the process usually terminates in resolution, followed by some atrophy of the organ, although pus formation may occur.

TREATMENT.—The local treatment consists largely of elevation, support, and compression. The patient should be put to bed and an ice-bag applied or a lead and opium wash. When the acute symptoms have subsided the patient may be allowed to get up, but the support should be continued. At this time an ointment composed of ichthyol, one drachm to an ounce of vaseline, may be used to advantage.

TUBERCULAR DISEASE OF THE TESTIS.

This lesion is most frequent in young adults giving a tubercular history. It is often primary, but may be secondary to a tubercular process elsewhere. The process commences in the great majority of cases in the epididymis. Tubercles are formed around the capillaries, they coalesce, caseate and are surrounded by an inflammatory exudate producing a node. The lesion is usually confined to the globus major or may affect the entire epididymis and cause marked enlargement. It not infrequently extends along the vas to the vesiculæ seminales, prostate and neck of the bladder. It may also extend into the testicle.

SYMPTOMS AND COURSE.—The process is usually primarily unilateral, but the other testicle may become involved at a later date. The inflammation may come on abruptly with severe pain and then gradually subside into a chronic condition.

Commonly the onset is gradual. A small, non-sensitive nodule, which can readily be separated from the testicle, appears in the lower end of the epididymis. This node may be followed by others higher up.

The lesion is slowly progressive. The skin overlying the node becomes adherent, pus forms and is discharged, leaving a fistulous tract.

DIAGNOSIS.—This may be based upon the chronic course which will readily differentiate it from the acute pyogenic infections, and from syphilitic epididymitis, by an absence of pain in the latter disease, and a history of a syphilis with the favorable results secured from specific treatment.

TREATMENT.—The general system should be supported. Fresh air, plenty of nourishing food, and a not too active life are indispensable conditions for relief. Slight local irritation by the use of ichthyol ointment, with support, may be of benefit. If the condition is progressive the nodule should be thoroughly excised. If the entire epididymis is implicated and the gland free the epididymis may be removed with the vas high up. If the testicle proper is involved it should be removed.

TUMORS OF THE TESTIS.

These may be benign or malignant. The most frequent form of benign growth is the adenoma which seemingly has its origin from the remnants of the Wolffian body. The tumor is round, soft, elastic and com-

posed largely of cysts. The cysts often communicate with one another and are lined by cuboidal or stratified epithelium. The walls of the cysts are made up of fibrous tissue. The tumor is situated within the testicle which is expanded over its surface.

CLINICAL COURSE.—These tumors are met with in young adults. They are of uniform growth, without pain or general discomfort except from their size.

TREATMENT.—This is early removal. The cord should be divided high up and the growth shelled out of the scrotum.

MALIGNANT GROWTHS.

These are the sarcomata, the endotheliomata, and the carcinomata. The sarcomatous and endotheliomatous growths may be considered together. They have their origin from the connective tissue of the organ and from the endothelial cells lining the lymph and blood vessels. The sarcomatous growths are made up of either round, spindle, or giant cells in connection with fibrous tissue. If the connective tissue is considerable they are known as fibro-sarcomata. The endothelial tumors are composed of endothelial cells, and have practically the same clinical characteristics as do the sarcomatous growths.

CLINICAL COURSE.—The sarcomatous growths of the testicle are extremely malignant, they occur in infancy and young adult life as rapidly-growing tumors. They are round or lobulated, elastic, and may have a uniform consistency, or be made up in part of cysts. The cysts are due to degeneration in certain tumor areas into which hemorrhage occurs. The growth is likely to extend along the cord into the abdomen and also to implicate the skin. These growths often follow an injury apparently as the exciting cause.

DIAGNOSIS.—This will depend upon the rapidity of the growth, the age of the patient, the presence of cysts and the interference with the health. The prognosis is unfavorable.

TREATMENT.—This consists in early and free removal, cutting out of the tumor with any portion of the skin that seems to be implicated, and removing the cord with the growth as high as the inguinal canal or internal ring.

CARCINOMA OF THE TESTIS.

This is a glandular carcinoma coming from the epithelial cells of the gland.

CLINICAL COURSE.—They are rapidly-growing, very malignant tumors, which occur after middle life. The skin and cord early become implicated, as well as the lymphatic glands of the groin and abdomen.

DIAGNOSIS. Will depend upon the rapid growth, the implication of but one testicle, the age of the patient, which is beyond middle-life, the implication of the skin, cord, and lymphatic glands, the interference of the general health, and the very considerable pain which accompanies the growth

PROGNOSIS The chances are very unfavorable under ordinary conditions, as carcinomatous growths of the testicle always show a high grade

TREATMENT.—This should consist in an early and very free removal of the tumor and all the implicated structures, such as adherent skin and the cord well up into the inguinal canal. In cases which are at all advanced, the inguinal region should be opened by incision and the glands removed on the side corresponding to the growth.

HYDROCELE.

This is a collection of serous fluid either in the tunica vaginalis or in the cord. The following varieties may be described:

ACUTE HYDROCELE.

This form may occur as a complication of orchitis or epididymitis, the inflammation extending to the tunic. The process may also be the result of a traumatism. The inflammation in these cases runs an acute course and usually ends in resolution in a week or ten days. The elastic and fluctuating sac can usually be made out surrounding the anterior and lateral surfaces of the testicle.

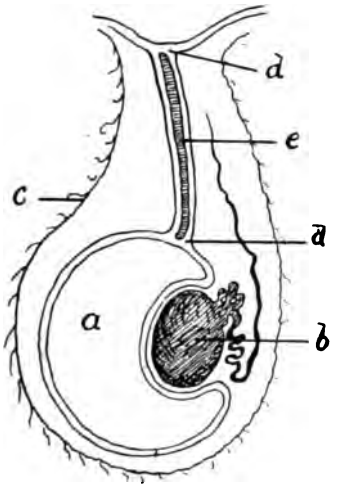


Fig. 142.—Vaginal hydrocele. a.—Hydrocele of tunica vaginalis. b.—Testicle. c.—Scrotum. d.—Upper and lower constriction. e.—Obliterated peritoneal pouch.

TREATMENT.—When occurring as a complication the treatment is that of the orchitis or epididymitis. When it is the result of a traumatism, rest, elevation, and support, with cold compresses during the first days is all that is indicated.

ACQUIRED VAGINAL HYDROCELE.

This is the most common variety of hydrocele and is that in which the tunica vaginalis becomes distended with a serous fluid (Fig. 142).

CAUSES.—It is often the result of an injury or irritation which sets up a chronic inflammation in the serous membrane resulting in increased secretion.

SYMPTOMS.—There is a slowly-growing, painless, pear-shaped tumor which surrounds the testicle on the front and sides. The condition usually

occurs primarily in infancy or young adult age. The tumor is tense, elastic, and fluctuates. If a candle is held opposite the tumor in a dark room, the light is seen to pass through the hydrocele, that is, it is translucent. If the fluid within the sac is mixed with blood or the walls of the sac are very thick, it will not transmit light. The tumor is without impulse on coughing and is dull upon percussion. Its form and size are not changed when the patient lies down or by making pressure upon it (Fig. 143).

DIAGNOSIS.—This is based upon its slow, painless growth, globular form, translucency, and the further fact that the tumor does not change its size or form in consequence of pressure or when the patient lies down. In doubtful cases a needle may be introduced which will demonstrate that the tumor is cystic and contains a serous fluid.

TREATMENT.—This is palliative and curative.

Fig. 143.—Hydrocele, right side.

Palliative Treatment. Consists in drawing off the fluid through a small trocar or needle.

Curative Treatment. This may be considered under a variety of headings. One of the methods of treatment is to aspirate the contents and then inject a solution of zinc sulphate, one grain to an ounce. The quantity injected should equal the amount drawn off. This fluid is to remain within the sac until it causes very considerable pain, when it is allowed to flow off through the canula. Instead of the zinc sulphate, two drams of strong tincture of iodine may be injected and allowed to remain within the sac. In this case when the needle is withdrawn the sac should be manipulated so as to bring every part of it in contact with the iodine. The purpose of this treatment is to convert the chronic into an acute inflammation by an aseptic

irritant. The plastic exudate which occurs unites the surfaces of the serous membrane and thus obliterates the sac.

These methods of treatment are frequently unsuccessful and have to be repeated.

A very popular method of treatment is that by which the sac is excised. After thoroughly aseptisizing the scrotum the tumor is fixed by grasping its posterior surface with the left hand, when a free incision is made through its anterior surface. After the discharge of the fluid the serous membrane is peeled out by the fingers and a sponge cloth, up to the border of testicle, where it is removed. The wound is united and the sac drained for a few days under compression.

CONGENITAL HYDROCELE.

In this condition the funicular process of peritoneum which comes down with the testicle has not been shut off at the internal ring. This allows the fluid from the abdominal cavity to reach the testicle when the patient stands, producing the appearance of an ordinary hydrocele. When

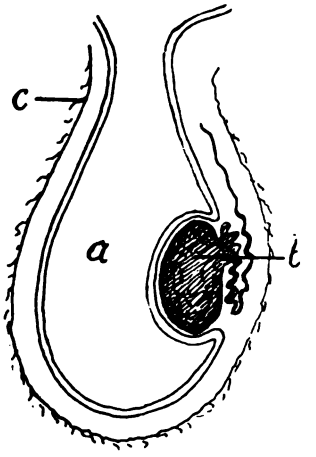


Fig. 144.—a.—Congenital hydrocele. b.—Testicle. c.—Scrotum.

the patient is recumbent, the fluid flows back into the abdomen and the tumor disappears. The condition occurs especially in infants and is usually associated with a congenital hernia (Fig. 144).

DIAGNOSIS.—It is to be differentiated from hernia. Translucency and fluctuation are the distinguishing symptoms.

TREATMENT.—In infancy and early childhood the wearing of a truss will often effect a cure. When this measure does not succeed, the patient should be operated, the operation being practically the same as that for congenital hernia.

INFANTILE HYDROCELE.

Is due to the funicular process remaining open except at its upper extremity. The fluid about the testicle extends along the cord even into the inguinal canal (Fig. 145-a).

TREATMENT.—The treatment is the same as that for an ordinary hydrocele.

ENCYSTED HYDROCELE OF THE CORD.

In this condition the funicular process has been obliterated at the internal ring and above the testicle, leaving that portion situated within the cord open (Fig. 146). In consequence of this a cyst is produced which fluctuates and has the above limitations. It is to be treated as an ordinary hydrocele by tapping and injections, or by enucleating the sac (Fig. 146).

VARICOCELE.

Consists in an enlargement and elongation of the veins of the cord, the pampiniform plexus. The condition becomes manifest before or shortly after puberty. It is usually situated upon the left side.

CAUSES.—Youth is evidently a very marked predisposing cause. A lax condition of the tissues, and a want of tone in the nervous system, are

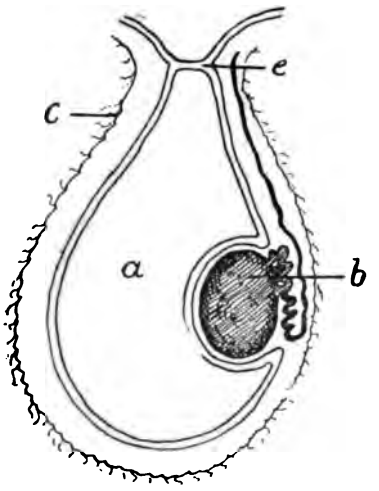


FIG. 145A.
a. Infantile hydrocele.
b. Testicle.
c. Scrotum.
e. Constriction at outer ring.

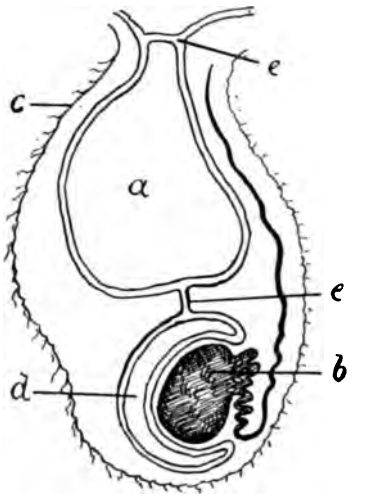


FIG 145B.
a. Encysted hydrocele of cord.
b. Testicle.
c. Scrotum.
d. Cavity of tunica vaginalis.
e. Upper and lower constrictions.

also important factors. The frequency of varicocele upon the left side has been explained by the entrance of the left spermatic vein into the left renal vein at a right angle, and also to the supposed influence of the sigmoid producing pressure upon the left vein, and the seeming further fact that the left cord is usually slightly longer than the right.

CLINICAL SIGNS.—The affection is represented by a soft, irregular, pyramidal growth or swelling situated in the left side of the scrotum. The swelling imparts to the fingers a feeling as though it was composed of a bunch of worms. The outlines of the enlarged and tortuous veins can be seen through the skin. In the recumbent position the swell-

ing disappears. It receives a slight impulse on coughing. There is a sense of weight and distress in the varicocele, with mental depression, weakness, and general nervousness.

DIAGNOSIS.—This is usually readily made. The affected side of the scrotum is elongated. There is a pear-shaped tumor which may be very irregular on its surface in consequence of the enlarged veins. The cord at the site of the external ring is not enlarged. Nothing can be felt coming out of the inguinal canal. The process disappears when the patient lies down. There is an absence of fluctuation and translucency.

TREATMENT.—*Palliative.* The scrotum should be bathed night and morning with cold water, while tonics, and especially strychnin, are given. A scrotal suspensory bandage should be worn.

Curative Treatment. An operation which has given marked satisfaction is carried out as follows: After thorough cleansing of the scrotum

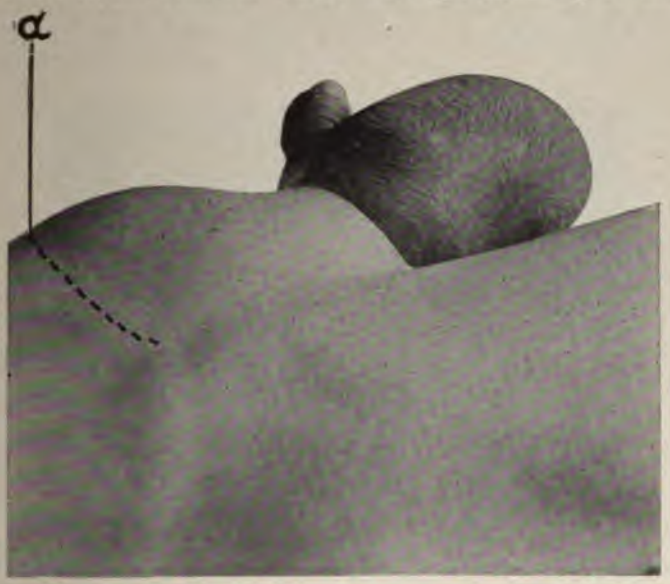


Fig. 146.—Encysted hydrocele of the cord which has passed through the funicular process and inguinal canal producing a large tumor in the abdomen. a—Upper limit of tumor in abdomen.

an incision is made about two inches long directly over the cord and above the testicle. The incision is deepened until the veins of the cord are reached. The cord is then brought out of the wound by the fingers when the vas deferens and the small vessels immediately adjacent thereto are separated from the remaining tissues of the cord for about two inches. The cord is then clamped at the upper and lower limits of this separation and removed, the extent of the removal depending upon the amount of shortening or lifting of the testicle which is desired. Before removing the clamps the vessels upon the cut surfaces of the cord are separately ligated with fine non-chromicized cat-gut. The forceps is then removed and if there are

any bleeding vessels these are also ligated. The ends of the divided cord are then brought together with three or four stitches of fine non-chromicized cat-gut. The skin is closed by the continuous, subcuticular, or interrupted suture. The dressings are so arranged and the bandages so applied as to give perfect support to the scrotum. The results of the operation are most satisfactory.

CHAPTER IX.

ULCERATION, GANGRENE, BURNS, FROST-BITE

An ulcer is due to a superficial loss of substance implicating the ski or mucous membrane. In an ulcer one of two processes may predominate the reparative or the destructive. If the growth of granulation tissue progressive and unhindered the ulcer readily heals; if the molecular deat or necrosis of tissue is greater than the reparative tissue, the ulcer graduall or rapidly increases in size.

Fig. 147.—Acute ulcer produced by the application of ice in a case of appendicitis.

The causes of ulceration are various. Some ulcers develop during th course of chronic infectious diseases, as in tuberculosis, syphilis, glander and leprosy. Others develop during the course of a malignant disease,– the sarcomatous and carcinomatous ulcers. Ulcers may develop as the re sult of widespread disturbances of nutrition, as in scurvy,—scorbutic ulcer They may be due to pressure and an extremely weak capillary circulation, a occasionally occurs in typhoid fever or other infectious disease,—decubitu ulcer or bedsore. Rapidly spreading ulcers frequently form as the resu of the withdrawal of nerve energy, as in cases of fracture or dislocatio of the spine,—neuro-paralytic ulcers. Ulcers frequently occur as the resu of disturbances in the venous circulation, leading to passive congestion, ir duration of tissue, and a want of proper nutrition,—varicose ulcer.

Ulcers are most frequently due to mechanical, chemical, thermal, an bactericidal influences (Fig. 147).

Macroscopically a healthy ulcer is covered with granulation tissue which appears as small red elevations of the size of a pin's head. In ulcers which are stationary or show retrograde changes, the granulations are often very small, pale, quite firm, and have a low state of vitality. Upon the surface of such an ulcer small or large areas are to be seen in which the granulation tissue has undergone necrosis.

Fig. 148.—Acute rapidly spreading ulceration of the leg, following infection of a punctured wound.

HISTOLOGY.—The microscopical section of a healthy ulcer shows various layers. The first is made up largely of small round cells, leucocytes and epitheloid cells. This layer is very vascular in consequence of the many new-formed capillaries. There is very little intercellular substance. Beneath this layer the epitheloid cells are more numerous, while

the intercellular substance, which may be amorphous, granular or finely fibrillated, is very much increased. Beneath these layers, fibrous tissue more or less changed and infiltrated with round cells is to be seen. All the layers are more or less infiltrated with blood serum.

Ulcers are also divided into acute and chronic. An acute ulcer is one which forms or spreads rapidly. The process is either due to infection or to withdrawal of the blood supply or nerve influence (Fig. 148). The base and borders of such an ulcer are covered with necrosed or sloughing tissue. A chronic ulcer is one which shows little or no tendency toward repair.

Ulcers are also classified according to certain clinical characteristics. Thus an ulcer is said to be *healthy, fungous, erethistic, callous* or *phagedenic.*

A HEALTHY ULCER.

One in which the surface is covered with red granulations and the borders show a bluish line of cicatrization. Such an ulcer gives off a free serous or sero-purulent discharge, is the site of but little pain, while its surface shows no necrosis of tissue. The blood supply of a healthy ulcer is free, and the surrounding tissues are healthy.

TREATMENT.—The essentials in the treatment of a healthy ulcer are to keep it at rest, protect it from irritation and injury, and to maintain its surface, so far as possible, in an aseptic condition. The ulcer may be cleansed once or twice a day with a mild antiseptic solution and covered with zinc ointment, compress and bandage.

FUNGOUS ULCER.

In the healing of an apparently healthy ulcer the granulations may become exuberant or fungous. In consequence of this exuberance they project above the surface of the skin and hinder or prevent epidermization. When this condition is present the exuberant granulations should be destroyed or removed. This may be accomplished by the application of silver nitrate in stick or with the shears or knife.

ERETHISTIC, PAINFUL OF IRRITABLE ULCER.

This name is applied to ulcers which are very sensitive and painful. A painful ulcer is unhealthy, in that the granulations are small, the formation of granulation tissue practically at a standstill or the ulcer shows areas of necrosis. It has been held that the cause of this condition was the exposure of a sensitive nerve upon the surface of the ulcer. The more likely cause is continued or intermittant irritation with infection. These ulcers occur with especial frequency at the border of an ingrowing toe-nail, at the anus within the grasp of the sphincter muscle, and just above the internal malleolus, or over the crest of the tibia. In these conditions irritation and infection are always present.

TREATMENT.—The indications are to relieve the cause as far as possible, get rid of the infection, and to protect the ulcer from irritation and injury. If the ulcer is situated within the grasp of the sphincter, the muscle should be dilated; if being irritated by the nail, the border should be removed; if there is caries or necrosis of the tibia, the dead bone should be cut away, and the parts, as far as possible, asepticized and protected.

The application of a soothing ointment containing five grains of ex tract of opium to the ounce of zinc ointment or vaseline, is often very bene ficial in these cases. If the ulcer is atonic or indolent, the application o moist heat by means of compresses is very serviceable.

THE CALLOUS, INDOLENT, OR ATONIC ULCER.

By this is meant a chronic ulcer in which the reparative process i at a standstill. The causes of this condition are general debility from over work, poor or insufficient food, and bad hygienic surroundings. Locall there is disturbance in the circulation in the form of chronic venous con gestion with lessened arterial blood supply, irritation and infection. A good example of such an ulcer is one which occurs above the internal o external malleolus in a laboring person suffering from varicose veins,— varicose ulcer.

In such an ulcer the surrounding tissues are inflamed, thickened, in durated, and œdematous, the ulcer has a hard, callous base and borders and the edges are elevated in consequence of the extraordinary growth o the epithelium incident to the chronic irritation; the surface of the ulce is covered with small, pale, indolent granulations and necrotic tissue; th discharge is often profuse, owing to the infection and necrosis of tissue the induration of the base and borders of the ulcer is due to the excessiv growth of fibrous tissue and the inflammatory exudate.

TREATMENT.—The indications to be met in the treatment are to im prove the general condition of the patient by rest, good food, better hygieni surroundings, and the administration of tonics. Locally, irritation and in fection are to be corrected and the blood supply improved. The bes method of meeting these indications in case of a large varicose ulcer abov the ankle is to place the patient in bed, elevate the limb, irrigate the ulce with hot carbolized solutions, night and morning, and apply large com presses wrung out of hot carbolized water, over which is to be placed a rubber protective. The limb is then enveloped in a layer of absorbent cot ton and a snug bandage applied. The compresses should be changed nigh and morning. The venous congestion is relieved by the rest in bed, th elevation of the limb, and the application of the bandage; the infection i corrected by the irrigations and the application of the compresses; whil the heat and moisture stimulates the absorbents, so that the exudate an excess of fibrous tissue are absorbed, and the arterial blood supply increased The great majority of varicose ulcers may be cured by this method o treatment in ten days or two weeks. After the ulcer has healed and th patient is allowed to be on his feet, the new tissue should be protected fron irritation and injury by zinc ointment and compress, absorbent cotton, an a well-fitting bandage.

PHAGEDENIC ULCER.

This ulcer is due to a virulent infection, coupled with a low state o general vitality. A phagedenic ulcer may occur following one of the in- fectious diseases, as in cancrum oris, following scarlet fever, or upon the dorsal surface of the body during a severe attack of typhoid fever. Pha- gedenic ulcers may occur about the genitalia in venereal diseases, upon the buttocks, scrotum, and thighs; following fractures of the spine; and upon scorbutic surfaces in severe cases of scurvy.

Sometimes the course of a phagedenic ulcer represents an acute, virulent, and rapidly spreading process. There is then usually marked depression, decided fever, and often chills. The surface of the ulcer is covered with necrosed and sloughing tissue. The discharge is purulent, offensive and profuse; the ulcer rapidly extends, and the surrounding tissues are greatly swollen. Unless the infection is gotten under control, the patient may succumb as the result of exhaustion, severe pain, septicæmia, or pyæmia.

TREATMENT.—The indications for treatment are twofold, to support and nourish the general system which is in a debilitated condition, and to relieve the local virulent infection. The former requirement is met b the administration of liquid food at frequent intervals, together with suc tonics as quinine and strychnin. Locally the ulcer should be asepticize and this can only be accomplished by curetting or cutting away practi ally all of the infected tissue; then swabbing the area with pure carbol acid, followed by alcohol; compresses wrung out of a hot carbolized sol tion should then be applied to the wound and covered with a dry dres ing supported by a bandage. In cases which are extending rapidly a are extraordinarily virulent, and if the position of the ulcer will warra constant irrigation with some mild antiseptic solution may be resorted to.

In large ulcers due to burns or avulsion of tissue, the mechanical di culties in the way of healing by granulation tissue are very great. In th cases skin-grafting should be resorted to.

MALIGNANT ULCERS.

These are always due to the breaking down of carcinomatous or s comatous tissue. The former are more frequently the site of ulceration t the latter. The granulation tissue in some of the malignant ulcers is m exuberant,—a mass of considerable size of soft granulation tissue bei produced in a single day. In other cases the surface of the ulcer is c ered with necrotic tissue or gangrenous sloughs. The discharge in case malignant ulcer is usually profuse and offensive. Such an ulcer is of the site of a severe hemorrhage. The ulceration is always progress and cannot be made to heal by any of the ordinary methods of treatme

The epitheliomatous ulcer, as it occurs upon the surface of the sk is characterized by induration of its base, scanty granulation tissue, slow vance, and refusal to heal under ordinary methods of treatment. The d charge from an epitheliomatous ulcer is slight, and hemorrhage rarely curs (Fig. 149).

TREATMENT.—Epitheliomatous ulcer of the surface may be treated, a often with great advantage, by the use of the X-ray. If this treatment not thought advisable, and the situation of the ulcer is suitable, it sho be freely excised. It may be desroyed by the actual cautery or by chemic

FISTULA AND SINUS.

A fistula may be congenital or acquired. It is an abnormal opening tween two cavities or between a cavity and the surface of the body. T branchial fistula, fistula of the thyro-glossal duct, and fistula of the rect at birth, are examples of congenital fistulæ. The acquired fistulæ are us the result of an operation, a traumatism, or an abscess.

ulæ acquire names according to the cavities with which they co

municate, as the vesico-vaginal fistula connecting the bladder and vagina, the recto-vaginal, pleuro-cutaneous, biliary-fecal, œsophageal, and urethro-perineo-scrotal—and many others which might be mentioned.

The treatment of these fistulæ belongs to the special branches of surgery.

SINUS.

This may be defined as an abnormal opening reaching from the surface of the skin or mucous membrane to the cavity of an unhealed abscess. A sinus is open at one end and closed at the other. It is lined with

Fig. 149.—Malignant ulceration of buttock following the healing of a burn.

granulation tissue. A sinus is usually formed in consequence of an abscess failing to heal, and which opens upon the surface of the skin or mucous membrane. The occasion of the failure in the healing of the abscess is often the presence of some foreign body. This may be an infected ligature, a piece of bone, clothing, sponge, bullet, or other foreign material. It may be due to imperfect or circuitous drainage, want of rest, or tubercular infection of the canal or abscess; it may be due to the growth of epithelial cells in the form of a tube down into the sinus, or to general debility.

TREATMENT.—In the treatment the cause must be removed. Any foreign body which is present in the depths of the wound or abscess cavity, must be removed. Knots of silk and other small foreign material, and unhealthy granulation, may be removed by gentle curettage of the cavity and sinus. Dependant and direct drainage may be secured when necessary by making new openings. The sinus and cavity should be as far as possible asepticized and kept clean.

GANGRENE.

By gangrene is meant the death of tissue *en masse*. If the process is confined to the soft tissues it is usually termed sloughing, if to bone it is known as necrosis, but when it includes both the soft and hard tissues, and especially when occurring in a limb, it is known as gangrene.

This lesion is represented by five cardinal symptoms:

1. Loss of pulsation in the arteries.
2. Loss of heat.
3. Loss of sensation. The part may be the seat of severe pain during the process of death of the tissues, and of referred pain thereafter.
4. Loss of function.
5. Change in color. A gangrenous limb may be purple, mottled, or black, depending upon the amount of contained blood. If the gangrenous area is quite bloodless, it will be of a waxy, yellowish color.

CAUSES.—Gangrene may result from a cessation of the arterial blood supply, due to an embolus or thrombus in the main artery; to obstruction of the venous outflow; to traumatism; thermal influences; or intense infection.

Gangrene due to interference with the circulation is divided into the dry and moist varieties. Dry, or senile gangrene, occurs in persons advanced in years and is due to a gradual withdrawal of the arterial blood supply in consequence of calcareous degeneration of the smaller arteries. The vessels are pipe-stem-like, inelastic, and their lumen narrow. The limb becomes anæmic and in a state of mal-nutrition. The heart's action is weak and the blood pressure often lowered. The tunica intima is usually rough, favoring thrombosis upon the least provocation, such as a slight traumatism, the paring of a corn, or the effects of cold. Before the onset of the lesion there will ordinarily have been manifestations of mal-nutrition, such as heaviness and cramps in the leg, pricking as of pins and needles, and cold feet. The circulation in the tibial vessels is often scarcely perceptible, while the skin is passively congested, both conditions favoring ulceration. The process usually commences in the great toe as a small, painfully reddened area, which goes on to ulceration and the formation of a dark, adherent slough. The surrounding tissue may or may not be inflamed. The process gradually extends and often invades the adjacent toes, the instep ankle, and even the leg. The gangrenous part becomes black, shrunken, and of a leather-like hardness. The odor in a case of dry gangrene is very slight. Death of tissue progresses until an area is reached in which the circulation is sufficient to maintain the vitality of the parts. The extent of the process will depend in a measure upon the presence or absence of infection. Pain in the gangrenous area is always severe, and often excruciating. When the process becomes arrested, the so-called line of demarcation between the dead and living tissue is formed. This line is easily made

out, because upon the one side there is living, but slightly inflamed tissue; while on the other the tissue is yellowish-green, gray or black.

The Process of Separating the Living Tissue from the Dead.—The adjacent living tissue becomes inflamed, while leucocytes and blood plasma invade the immediately contiguous dead parts. A progressive and deepening line of granulations is formed upon the side of the living tissue; and by the process of auto-digestion and disintegration the line of demarcation is deepened, and the dead parts gradually separate from the living.

In consequence of the severe pain, septic absorption, loss of sleep and inability to take food, the patient becomes greatly exhausted, and may succumb to the process.

The diagnosis will depend upon the presence of the five characteristic symptoms.

In the prognosis one will be guided by the general condition of the patient; extent of the gangrenous process; the condition of the circulation; and the presence or absence of infection. As a rule the prognosis is grave

TREATMENT.—The patient's general nutrition should be maintained in the best possible condition. Locally the parts must be kept as nearly as possible aseptic. The gangrenous area may be dusted with iodoform and boric acid, equal parts, and enveloped in sterilized gauze, over which is placed a quantity of absorbent cotton, the dressing being held in position by a bandage. With the arrest of the gangrenous process, an amputation may be done just above the line of demarcation, or without waiting for this line, if the surgeon is able to establish a point not too high at which the circulation is good, he may amputate through this area.

MOIST GANGRENE.

In this condition the vessels and tissues at the time of the death of the part are filled with fluids. The lesion is caused by the sudden arrest of the arterial blood supply from the main vessel, by an embolus or thrombus, ligature or traumatism. It may also be caused by the sudden arrest of the venous outflow. Moist gangrene is almost certain to occur if both the main arterial and venous vessels are obstructed. In a patient of reasonable vitality, the main artery of a limb may be ligated or obstructed by an embolus and the vitality of the part be preserved. But in a patient advanced in years, with diseased vessels, poor circulation and a lowered state of vitality, death of the part is likely to occur with obstruction of the main vessel. In a young person with occlusion and laceration of the main artery, and the vitality of the parts much reduced in consequence of the injury, gangrene of the limb is also likely to occur.

SYMPTOMS AND COURSE.—There are five cardinal symptoms of gangrene: The circulation disappears in the vessels; the limb becomes cold, lifeless, numb, and markedly swollen, a pin can be thrust into it without causing pain; the limb cannot be used, and it is often the site of severe pain; the skin is not only cold but it feels sodden, non-elastic, and lifeless; the color does not change perceptibly for a day or two, then the skin assumes a waxy, yellow tinge, then becomes purple or gray, and finally black. Upon the surface at various places the epithelium is raised in the form of blebs, filled with a bloody fluid. If the part affected is a lower extremity, the process is first manifest in the toe, and extends from there up the limb.

If the gangrenous area could be kept absolutely aseptic it would remain without odor, become dry from evaporation of fluid, and be separated from the living tissue without marked fever or special systemic disturbance. Such a condition rarely occurs in practice. The blebs become filled with a very offensive fluid, and from the limb emanates an extremely disagreeable and penetrating odor.

PRINCIPLES OF TREATMENT.—These are to maintain the vitality of the system at the highest possible standard, to prevent infection, support the circulation, and maintain heat in the part. The general system is supported by giving liquid nourishment at frequent intervals, and administering such tonics as quinine, iron, and strychnin.

Fig. 150.—Traumatic gangrene of the hand from a crush between rollers.

Local Treatment.—In case of impending gangrene, the limb should be asepticized with the same care as would be used before an operation. The limb being thoroughly washed with soap and water, swabbed with alcohol and bichloride, is dried and freely dusted with iodoform and boric acid. It is then enveloped in sterilized gauze, while over this is placed a thick layer of absorbent cotton, supported by a bandage. The limb is then elevated on pillows and kept warm by the use of bags of hot water. When the line of demarcation has formed the limb should be removed just above the line. In cases in which infection has occurred the fluid in the blebs becomes offensive, the limb softens, the tissues are easily lacerated and crackle when the limb is handled. The patient suffers from sepsis and the

process is likely to extend rapidly upwards. In such a condition the line of demarcation must not be awaited for, because it is not likely to form. The process is now one of spreading infection, and the limb should be amputated through healthy tissue well above the highest point of infection.

TRAUMATIC GANGRENE.

By this is meant the death of tissue as the result of an injury. The injury may be direct as applied to the tissues whose vitality is destroyed, or indirect, as applied to the main blood vessels. In the direct injury the blood vessels are lacerated or thrombosed, while the vitality of the tissue is greatly lowered in consequence of the injury (Fig. 150).

In the treatment the parts should be thoroughly asepticized, and all tissues which are evidently dead removed, provision made for free drainage, and the part enveloped in a large antiseptic dressing, supported by a bandage and subsequently kept warm.

Fig. 151.—Diabetic and senile gangrene.

SPREADING TRAUMATIC GANGRENE.

One of the great dangers in any case of gangrene due to traumatism is the possibility of the occurrence of an acute infection, which, aided by the low vitality of the tissues, may spread up the limb with rapidity and cause the death of the patient.

Prophylactic Treatment.—This consists in thoroughly asepticizing the wound, removing all dead tissue, and affording free drainage. If the inflammation commences to spread up the limb, free incisions should be made for the purpose of letting out pus and infectious material and affording drainage. If the inflammatory process is intense, and followed by gangrene of the affected limb, and the constitutional symptoms are pronounced, high amputation should be done through healthy tissues.

DIABETIC GANGRENE.

This lesion usually commences upon one of the toes, as a small inflamed area or bleb, which soon ulcerates, showing a necrotic base. From this area

the process may gradually extend to the foot or adjacent toes. The condition seldom occurs except in old people suffering from diabetes and hardened arteries. It is due to the depraved condition of the blood in consequence of glycosuria, and to arterio-sclerosis (Fig. 151).

DIAGNOSIS.—In every case of gangrene commencing in a toe, without assignable cause, the urine should be examined for sugar.

TREATMENT.—The diet should be regulated and the diseased part maintained in an aseptic condition. Operative measures are seldom justifiable, as the flaps are likely to become gangrenous and the process be advanced rather than checked. The use of an anæsthetic for operative purposes nearly always increases the amount of sugar in the urine.

GANGRENE FROM ARTERIAL THROMBOSIS.

This condition is not dependent upon age, but may occur in young persons, following the infectious diseases, severe toxæmia or local infection.

Fig. 152.—Diabetic gangrene in an old man.

The coagulability of the blood is increased and a local endarteritis occurs as the result of the toxæmia. If the process affects an extremity, the large artery may become thrombosed.

Indications for treatment are to maintain the part in an aseptic condition until such time as the line of demarcation is formed, when an amputation should be done.

RAYNAUD'S DISEASE, OR SPONTANEOUS SYMMETRICAL GANGRENE.

This is a condition occasionally met with, especially in anæmic, debilitated, and nervous women, between the ages of twenty and forty. It is seemingly due to vaso-motor spasm, or to a peripheral neuritis. Three stages have been described: First, local anæmia, or syncope, due to arterial spasm and characterized by pain and pallor of the affected part; second, local congestion of the affected area, the tissue being bluish or purplish in

color; third, necrosis, the affected tissue becoming black. The disease is usually symmetrical and affects the tips of the fingers, ears, nose, or cheeks. The process is without fever, but very painful.

TREATMENT.—As the condition occurs in anæmic, debilitated, nervous, and overworked individuals (especially women), these conditions should be primarily corrected in the treatment. The administration of iron, quinine, arsenic, and strychnin is usually serviceable. The patient should be put in the best possible hygienic condition, and allowed to rest.

GANGRENE FROM ERGOT.

A similar spasm of the vessels to that taking place in Raynaud's disease occasionally occurs from the use of ergot, or diseased rye in the manufacture of bread. In these cases the process may be limited to the tip of a finger or involve the major part of a limb.

HOSPITAL GANGRENE.

This condition frequently occurred before the antiseptic era, but is now practically unknown, in consequence of better hygienic surroundings and a more careful asepsis. The disease was characterized by a rapidly progressing swelling of the wound and limb, profuse watery, offensive discharge, with marked sloughing of the tissues, and great prostration.

TREATMENT.—The treatment, should the condition occur, would be to secure the best possible hygienic surroundings, such as fresh air, pure water and good food, and to maintain rigid antisepsis with free drainage. If the process extends rapidly amputation high up through healthy tissue should be done.

BURNS AND SCALDS.

These two injuries may for practical purposes be considered together, although they have some marked differences. Scalds are likely to be more extensive than burns, in consequence of the fluids being diffused by the clothing. In scalds the hairs are not destroyed and the tissues are ordinarily only superficially injured. Burns are usually less extensive, but likely to penetrate the tissues to a greater depth than scalds. Consequently the hair bulbs are frequently destroyed.

Burns and scalds have been divided into those of the first, second, and third degrees. In burns of the first degree there is only reddening or an erythema of the cutaneous surface. In burns of the second degree there is in addition to the erythema the formation of vesicles or bullæ; while in burns of the third degree, portions of the skin and even of the deeper structures are partially or completely destroyed.

CAUSES OF DEATH FROM BURNS.—Death may occur almost immediately, and is then evidently due to shock as a result of the extensive surface injured. Death may not be immediate, but occur during the first two or three days. In cases of delayed death some other cause than shock must evidently be assigned. In this class of cases there are hemorrhages and necrosis in one or more organs, hematuria and hemoglobinuria, with evidences of violent systemic intoxication. The following explanations have been offered to account for these phenomena: Suppression of the cutaneous functions in the involved area; changes in the nervous system due to re-

flex disturbances; the formation of toxic substances in the blood; the destruction of the blood elements; and the absorption of toxic materials from the injured area. Experimental research has shown that toxic substances are circulating in the blood, and are also present in the urine after the infliction of extensive burns. Herman Pfeiffer has demonstrated experimentally that after severe burns in animals the urine is first hemorrhagic and then albuminous, and if injected subcutaneously in healthy animals, it produces either necrosis of the parts or death of the animal. The toxicity of the urine increases from the time of the burn until about the fifty-sixth hour, when it gradually diminishes. Blood serum, when injected subcutaneously, produces practically the same results. Following these injections there is usually an intense paralytic effect upon the nervous system, or a severe disturbance of the intestinal canal. Pfeiffer was unable to demonstrate the exact nature of this toxic substance. His experiments agree in the main with those of many other investigators; so that at the present time it seems probable that the delayed deaths from burns are largely the result of some toxic substance circulating in the blood, which has been produced as a result of the injury—probably as the result of this toxic substance—and at a later period death may be due to pulmonary or gastro-intestinal inflammation, ulcer of the duodenum or œdema of the glottis. After suppuration has been established, death may be due to exhaustion, erysipelas, septicæmia, or pyæmia.

PROGNOSIS.—This will depend upon the extent and depth of the injury. Ordinarily the simple reddening of two-thirds of the cutaneous surface, or the destruction of one-third, will result in death.

SYMPTOMS.—In extensive burns there is primarily marked depression, profound shock, or even death. Following the reaction from shock, fever occurs, often followed by hemorrhage in or inflammation of internal organs. The local injury produces intense, often agonizing, pain. The pain is most severe in burns of the second degree, in which the sensitive nerve endings are intensely irritated but not destroyed. There is also local reddening, vesiculation or charring of the skin.

TREATMENT.—If the pathology outlined is correct, then the treatment should be directed to the correction of shock, the ridding of the system of toxic substances, the protection of the sensitive nerve endings from further irritation, the removal of destroyed tissue, and the prevention of infection.

Shock is controlled in cases not immediately fatal by large doses of morphine, caffein, and strychnin. The system is relieved of the toxic substances by removing dead tissues, cleansing the injured area thoroughly, opening the bowels, inducing the patient to take freely of fluids, and injecting subcutaneously, or into the rectum, quantities of normal salt solution.

Local Treatment.—In burns of the first degree the burned area may be cleansed and then covered with cloths wrung out of a saturated solution of bicarbonate of soda. In burns of the second degree the parts should be cleansed with some mild antiseptic solution, the vesicles or bullæ opened with a sterilized needle or bistoury, and the parts protected by moist antiseptic dressings. Picric acid solution has been used extensively for this

purpose. This is made by dissolving one dram and a-half of the acid in three ounces of alcohol and then adding two pints of sterilized water. After the part is cleansed, pieces of sterilized gauze are wrung out of this solution and applied to the injured area. The part is then enveloped in cotton and supported by a bandage. The dressing is left on (if it does not create too great irritation) for two or three days. It is then thoroughly moistened and removed and the burned area again irrigated, and a new moist dressing re-applied as before. In burns of the first and second degree I have derived the greatest satisfaction from the use of solutions of acetozone. The burned or scalded area is first irrigated with a solution of acetozone of 1 to 5000, and then compresses of gauze are wrung out of an acetozone solution of the strength of 1 to 2000, and applied to the burned area. These compresses are covered with absorbent cotton and supported by a bandage. The dressings are ordinarily changed night and morning. Burns and scalds of the third degree may be treated with the hot acetozone solution until granulation tissue has formed. The acetozone solution may then with benefit be changed for an oxide of zinc ointment containing one dram of powdered cinchona to the ounce, and two grains of extract of opium.

In cases of burns or scalds where large areas have been destroyed, and as soon as the wound has become covered with granulation tissue, skin-grafting should be resorted to.

FROST BITE.

By this is meant the effect of cold upon a part. As the result of cold the circulation may be greatly lowered and even arrested and the part congealed. The parts most frequently frozen are tips of the ears, the points of the cheeks, the tip of the nose, and the toes and feet. It is seldom that any harm comes from freezing the ears, but in the depth of winter in the northern states the toes and feet are frequently lost in consequence of being frozen. This unfortunate condition not infrequently occurs to persons who are lost in the woods, exposed to severe cold during long drives, or who lie out all night in consequence of intoxication. The harmful effects of freezing depend upon disturbances of the circulation. If this is arrested for several hours the vessels become thrombosed and the circulation is not reëstablished with the withdrawal of the frost. The part consequently dies. Following the withdrawal of the frost in an ordinary case there is always marked reactionary inflammation. If this is excessive, and the exudate pronounced, such pressure may be produced upon the enfeebled circulation as to cause its arrest and consequently the death of the part.

Symptoms.—There is at first a tingling or slight piercing pain in the affected area, then numbness and finally complete loss of sensation, when the part is congealed, white and icy cold to the touch. If the part is frozen but a short time, with the withdrawal of the frost it becomes inflamed, red, swollen, sensitive and painful. The heat in the injured area is also increased. After a few days the superficial epidermis peels off. The tissues which have been frozen remain sensitive, however, several weeks, and for months the circulation is enfeebled and the part more readily frozen. If the tissues have been frozen for several hours the circulation is usually not reëstablished after withdrawal of the frost, and the part remains pale and non-sensitive. After two or three days it becomes bluish and then

black. The fluids evaporate from the tissues and they become shriveled, dry, and hard—dry gangrene.

TREATMENT.—What is desired in the treatment is to withdraw the frost, reëstablish the circulation and prevent excessive reaction. The frost may be withdrawn and the circulation ordinarily reëstablished by rubbing and kneading the parts vigorously, preferably in a cold room. If the vessels are hopelessly thrombosed the circulation will not return. In these cases the part should be thoroughly asepticized and then enveloped in absorbent gauze, covered by cotton and a bandage, and elevated. It is absolutely necessary in the early treatment of frost bites to keep the patient out of a warm room and away from the fire. Heat in this class of cases during the first day or two will increase the reactionary inflammation and make more probable subsequent gangrene. If the reaction is excessive, evaporating lotions or cold may be applied.

CHILBLAIN OR PERNIO.

This is a circumscribed, superficial inflammation of the skin covering the toes, nose, ears, cheeks and fingers which occurs in young and debilitated subjects. The condition is presumably caused by an enfeebled circulation with sudden and extreme changes of temperature. Young, weakly persons who do not protect their feet or hands from the cold of winter, are extremely likely to suffer severely from this affection.

SYMPTOMS.—There is redness and swelling of the involved part, coupled with a most intense burning and itching. In cases in which the swelling is excessive, ulceration may occur.

TREATMENT.—The general debility should be corrected, and the feet protected by woolen socks, good shoes and overshoes, while extremes of temperature are especially to be avoided. For local application, lead-water and laudanum may be used, or tincture of iodine brushed lightly over the surface. Alcohol and water are also beneficial. A weak ointment of ichthyol with extract of belladonna is also serviceable, or a weak solution of adrenalin may be applied.

CALLOSITIES.

These are flattened, irregular thickenings of the epidermis. The condition is due to pressure and occurs especially upon the palms of the hands and the soles of the feet. Callosities on the soles of the feet, over the metatarso-phalangeal joints, may produce severe pain in walking.

TREATMENT.—The foot should be thoroughly washed and then the callosities gently but persistently pared away until all induration has disappeared.

WARTS OR VERRUCAE.

These papillomatous growths frequently occur in childhood. They may be single or multiple, large or small. Warts have certain peculiar characteristics. At times they make their appearance suddenly in crops, and quite as unexpectedly disappear. When occurring on the surface of the skin they usually have a slow, uniform growth, and after reaching a certain size, remain stationary, perhaps for months or years, and then may gradually disappear. At other times the growth is irregular, now rapid

and then slow, and then seemingly remains stationary. They are usually quite free from pain unless injured or inflamed, following which they may be extremely painful, ulcerate or bleed profusely.

Warts have been divided into three sub-classes:

First, the seed wart or verruca vulgaris. This variety frequently occurs upon the hands or portions of the body exposed to irritation, and forms large, hard, horny, flattened, irregular projections. They vary greatly in size and in color, but are usually darker than the normal skin.

Filiform warts, or verrucæ filiformes, form a second sub-class. These occur at the border of the nail or nails, as marginal, slightly elevated projections. They are usually quite soft, have a smooth surface, and correspond in color to that of the adjacent skin. They may form an uninterrupted elevated line, which almost completely encircles the border of the nail.

Fig. 153.—Normal skin.

To the third sub-class belong the flat wart, or the verruca planum. This is a flat, soft, smooth wart, often of considerable size, and of slight elevation.

Histology.—Microscopical section of a wart shows hypertrophy of the connective tissue of the papillæ and of the epidermis. The papillæ are not only much broadened but also enormously elongated. There is also a marked hypertrophy of the epithelial structures overlying the papillæ (Figs. 153 and 154).

Degenerative Changes.—A wart is liable, as a result of traumatism or infection, to inflammation or ulceration, and if pedunculated may in consequence of thrombosis of its main vessel, or torsion of its pedicle become gangrenous.

Diagnosis.—Under ordinariy conditions there is no difficulty in making a diagnosis of warts. They must, however, be differentiated from

epithelial growths of a malignant character. The soft wart, which does not present an exuberant growth of horny epithelium, would scarcely ever lead one into error. It is only those which have an excessively dry, horny, squamous epithelium that are likely to be mistaken for an epithelioma. Under ordinary conditions a wart is not indurated and does not present the hard, board-like base which is so characteristic of malignancy. The benign growth, unless it has been the seat of a recent traumatism or infection, is not likely to be ulcerated; and should ulceration occur it will respond to proper treatment.

PROGNOSIS.—Warts are benign growths. It must, however, be taken into consideration that as the result of irritation or long-continued infection they may take on malignant change.

Fig. 154.—Papilloma of skin. a.—Thickened horny layer of epidermis. b.—Proliferation of rete cells. c.—Hypertrophy of connective tissue papillæ.

TREATMENT.—In the cure of these growths the first consideration must be given to cleanliness. The part should be thoroughly washed with soap and water, as often as seems necessary, and carefully dried. An effort should be made to maintain the part in a thoroughly clean and dry condition. If more is necessary, an alcoholic solution of salicylic acid, 1 to 500, or a solution of formalin, may be applied to the individual warts, or they may be painted with a mixture composed of salicylic and lactic acid, each one part, to flexible collodion, six parts, the application to be repeated frequently for one week, when the warts will likely have disappeared. A 1 per cent. sublimate solution in tincture of benzoin is also to be recommended. A weak solution of carbonate of ammonium may be used in which to bathe the hands. Filiform warts, especially, have been known to disappear after this treatment. If the warts are solitary and persistent they may be clipped off with shears and the base lightly touched with the end of a toothpick which has been dipped in nitric acid; or if the warts are

large and extremely troublesome, nitric acid may be lightly applied to the surface with the end of a match; and after two or three days the parts which have been destroyed should be cut away with a sharp knife, when the second or third application may be made, if necessary.

CLAVUS OR CORN.

The corn is a flattened, circular, circumscribed thickening of the epidermis. This extends in the form of a cone below the normal level of the corium. Corns are the result of uncleanliness and the pressure either of the shoes or adjacent surfaces of the toes.

A corn situated between the toes is represented by a whitish or yellowish collection of epithelium which, being removed, shows a point of reddened and inflamed corium—soft corn. Beneath the soddened epithelium infection with inflammation and pus-formation are likely to occur.

In corns which are situated upon the external surface of the toes, the epithelium is compressed, desiccated and hard—hard corn.

Corns often cause a good deal of distress on walking, especially the soft, inflamed corn.

TREATMENT.—The shoes should be of sufficient size so as not to make undue pressure upon the feet, or to crowd the toes closely together. The hard corn, after cleansing the foot, may be pared until all of the hardened epithelium has been removed. This process is to be repeated as often as the dense epidermis accumulates. Very often, however, if the feet are kept clean and the pressure removed, the corn will not recur.

In the treatment of the soft corn, after proper cleanliness, the soddened epithelium is scraped or cut away with a knife. A thin layer of absorbent cotton should then be placed between the toes to absorb the moisture. With daily attention to antisepsis the inflammation readily disappears and the denuded area becomes covered with healthy epithelium. If the tenderness remains, the red area of the soft corn may be lightly touched with a solution of nitrate of silver of the strength of from ten to twenty grains to the ounce.

HYPERTROPHY OF THE NAILS.

This condition not infrequently occurs in elderly people in whom there is a marked tendency to epithelial proliferation. The nails in some of these cases are enormously thickened and elongated. They are usually irregular, thickened, twisted, quite dark, and very hard and brittle. They may be a half-an-inch or more in thickness, and in length quite double the normal. These enlargements are due to an overgrowth of the papilla and the enormous production of horny epithelium coming from the stratum lucidum. When the condition is pronounced it is unsightly, and interferes seriously with the wearing of shoes.

TREATMENT.—The nails are so thick, hardened, and brittle that it is almost impossible to pare them with a knife. A very excellent instrument for this purpose is a pair of strong bone forceps, with which the nails can be reduced almost to the normal in length and thickness in a few moments. It is not advisable to attempt to reduce the nail to its normal size, as this is scarcely practicable on account of the greatly hypertrophied papillæ. The cutting across of the papillæ causes quite a little bleeding and some pain.

CHAPTER X.

[illegible]ICAL AFFECTIONS OF THE BLOOD-VESSELS.

VARICOSE VEINS.

[illegible] said to be varicose when it is [illegible] [illegible]ous. The term is usually [illegible] [illegible]ous veins. The varicosity is [illegible] [illegible]ary weakness, as the condition [illegible] [illegible] family or in successive generations [illegible] [illegible] mentioned that any condition [illegible] [illegible] liable to cause its dilatation. [illegible] laboring people who are much [illegible] [illegible]ancy. Standing, the strain of lifting [illegible] [illegible] the pressure of tight garters, [illegible] [illegible] of abdominal tumors, and constipation [illegible] [illegible] the blood pressure in the saphenous [illegible] In some women pregnancy seems [illegible] [illegible]phena, aside from pressure, as the [illegible] [illegible]rst indication of pregnancy. It is [illegible] [illegible] tone in the muscular and nervous [illegible] [illegible] prominent factors in the production of [illegible] [illegible] become dilated, and its valves are no longer [illegible] [illegible] blood reaching from the right auricle to the [illegible] [illegible]ther and markedly to aggravate the mischief [illegible]

Morbid Anatomy.—Macroscopically the [illegible] vein appears elongated, widened, thickened, indurated, and tortuous. The walls are so thick that the vein does not collapse when divided, but presents a large open mouth. Microscopically the principal changes occur in the tunica media, which loses its muscular structure and is converted into fibrous tissue. The outer coat is thickened, while the tunica intima is seriously altered.

Clinical Appearance.—The enlarged, tortuous veins can be seen as blue cords ramifying under the skin. In places they become so much elongated, so tortuous, and the lateral branches so much dilated, that they form tumors of considerable size—varices (Fig. 156).

A varicose vein is composed of a mass of twisted and tortuous veins, [illegible]gether by connective tissue.

PATHOLOGY.—In consequence of the dilatation of the veins, and the incompetency of the valves, the superficial tissues in the limbs are in a state of chronic venous congestion. This interferes with the normal arterial blood supply and a proper lymphatic circulation, and as a result the skin and subcutaneous structures become thickened, indurated, and lose much of their vitality and power of resistance. In consequence of this low state of vitality, scratches, abrasions, or an eczematous inflammation may be the starting point of an ulcer, which becomes chronic and progressive.

Fig. 155 - Varicose veins of the legs.

Occasionally a vein ruptures producing an alarming hemorrhage. Some of these ulcers in old and neglected cases become so large and are surrounded by so much induration as to make amputation advisable. A periphlebitis often becomes established, in consequence of the pressure and irritation incident to the enlarged vein. As a result of this inflammation the veins are often almost inseparably connected with the skin.

A cure is effected in some cases of varicose veins in consequence of a traumatism, or an over distention being followed by thrombosis, with

subsequent permanent occlusion of the vein. An organized thrombus may contract, harden, become infiltrated with calcareous matter, and form a vein stone or phlebolith. A portion of a thrombus may become detached and float off in the circulation as an embolus.

TREATMENT.—This is either palliative or curative.

The Palliative Treatment. This consists in removing the cause in so far as possible, and in giving support to the enlarged veins. The bowels should be regulated and the patient kept off his feet as much as possible.

Fig. 156.—Varicose veins of the legs.

Complications—Eczema. Eczema, if moist, may be treated by the application of dilute alcohol and dusting powders, such as bismuth or oxide of zinc; if dry and scaly, by soothing ointments. If varicose ulcers are present they should be kept clean and protected by compresses wrung out of hot carbolized water, or by the application of oxide of zinc ointment. In addition, the veins should receive support by having the limb elevated and enveloped in sterilized gauze, a thin layer of absorbent cotton, and by bandaging. An elastic-webbing bandage composed of threads of rubber covered with cotton or silk gives excellent support in this class of cases. It is very much to be preferred to the elastic stocking, as it is much cheaper and can readily be applied by the patient.

The Curative Treatment. In all severe cases in which the bandage does not give relief, in which the veins are large, one threatens to rupture, ulcers exist, and the skin and subcutaneous tissues are much thickened or œdematous, the vein should be ligated or removed.

One of the most frequent operations is that recommended by Trendelenburg. In this operation the vein is exposed below the saphenous opening, double-ligated with cat-gut, and an inch or more resected. The purpose of the operation is to make a break in the long column of blood from the heart to the feet.

Technic. After proper preparation the patient is anæsthetized, and the femoral artery located two to three inches below Poupart's ligament. An inch internal to this an incision is made two inches long through the skin and superficial fascia. The vein is external to the deep fascia, is often as large as the little finger, and is readily found by making a little dissection with the handle of the scalpel in the subcutaneous fat. It is separated from the adjacent connective tissue and the fascia beneath by the handle of the scalpel, pulled into the wound, and two cat-gut ligatures placed about it two inches apart. The intervening portion is then resected and the wound closed.

The Superintendent of the Milwaukee County Hospital reports that in something over two hundred Trendelenburg operations done at that institution by different surgeons for varicose veins, the results were extremely satisfactory. In my work I am accustomed to double ligate and resect the vein in at least three places, below the saphenous opening, above the knee and in the calf of the leg. In some patients great masses of veins are found, and these should be exposed and removed. Above the knee, and especially over the calf of the leg, the enlarged vein is often closely adherent to the overlying skin. In these cases the skin is often thin, the walls of the vein very brittle and easily ruptured. In any given case in order to avoid injury to the vein, the incision should be made a little to one side, or, if directly over the vein, at first superficial, and then the skin is lifted with two forceps, as one dissects the adjacent skin on each side away from the vein. The vein may then be separated from the surrounding structures by the handle of the scalpel.

Dr. Charles Mayo removes the vein entire and subcutaneously from the knee to the saphenous opening. The more or less complete removal of the vein by open incision has been practised in severe cases by many surgeons. In one case, after multiple ligations and resections, I was obliged to resort to Schede's operation, that of making a circular incision almost completely around the leg, reflecting the flaps, and then separating, ligating and resecting every vein crossed. Before making this incision the limb should be rendered nearly bloodless. The results of the operation by multiple ligation and excision are eminently satisfactory.

THROMBOSIS AND EMBOLISM.

THROMBOSIS.

[illegible] is meant the formation of a clot of blood in some part of the [illegible] most frequently occurs in the veins, although

it may take place in the heart, in the capillaries or in an artery, as afte ligation (Fig. 157).

CAUSES OF THROMBOSIS.—The most frequent causes are infection and a roughening of the endothelial lining of a vein. The endothelial lining may be disturbed as the result of rupture, puncture, contusion, pressure, in fection, and inflammation. The formation of a clot or thrombus may a be favored by conditions of the blood. Thus the coagulability is increas after hemorrhage, in consequence of the presence of infectious materials calcium chloride in the blood. Thrombosis is also favored by slowing the blood current.

Thrombi are of three kinds. First, the white thrombus, or that which formed in circulating blood; second, the mixed thrombus, or one which formed in circulating blood, but contains a quantity of red corpuscles; a third, the red thrombus, or a clot containing all of the elements of t blood.

SUBSEQUENT CHANGES IN A THROMBUS.—(a) It may become organiz into connective tissue and occlude the vessel.

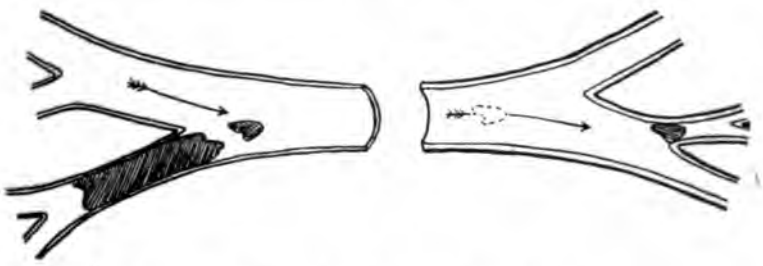


Fig. 157.—Thrombus and embolism—Embolus.

(b) After organization it may become partially absorbed, contract, become canalized.

(c) The clot may soften, disintegrate, and be washed away.

(d) It may shrink, become loosened, and subsequently become impre nated with calcium salts, producing a vein-stone.

THE RESULTS OF THROMBOSIS.—These are slight or insignificant if t vessel is small, the thrombus aseptic, and if it does not extend, or becon readily absorbed. In cases in which the thrombus is permanent and in reasonably large vessel, if the collateral circulation is readily establish the results are not serious. On the contrary if the thrombus blocks a lar vessel, such as the femoral or popliteal, it may lead to gangrene of the lin If the circulation in a considerable area of the mesentery is arrested, consequence of the formation of a thrombus, in the mesenteric vein, ga grene of the intestine may occur. An infected thrombus is likely to le either to local pus formation or pyæmia. An area which is normally drain by a thrombosed vein, especially if in an extremity, becomes swollen - edematous. An aseptic thrombus may break up into emboli which be rrested in the lungs or brain, with fatal effect.

SYMPTOMS.—The symptoms of thrombosis will depend upon the seat of the obstruction. In the extremities they are those of an arrested venous circulation plus phlebitis. The vein is usually hard, tender, swollen, and painful. The return circulation is interfered with, consequently the limb below the seat of obstruction is swollen and œdematous.

TREATMENT.—As a rule the patient should be confined to the bed, while the circulation is supported by properly-fitting bandages, and the general tone and vigor of the patient sustained by tonics. The immediate site of the thrombus should never be massaged, for fear of breaking the clot up into numerous emboli.

EMBOLUS.

This may be a detached portion of a thrombus, a vegetation from the heart, a globule of fat, or a bubble of air.

Emboli have been divided into (a) simple, when they consist of anv one of the substances mentioned; (b) infected, when they contain one or more of the pyogenic organisms; (c) malignant, when they are made up of the cellular elements of some malignant growth; (d) parasitic, when they are composed of the ova of some parasite, or of the parasite itself.

An embolus may have its origin in the heart or venous system, but it seldom becomes arrested except in an artery or in the ramifications of the portal vein. An embolus after becoming lodged in an artery usually increases in size, in consequence of a deposit of fibrin. Organization of the fibrin usually follows, and the obstruction of the vessel is made complete. More rarely an embolus disintegrates, or is absorbed, leaving a weak spot in the coats of the vessel, which may subsequently be the site of an aneurysm.

THE EFFECTS OF EMBOLISM.—If an embolus becomes lodged in the pulmonary artery it may cause instant death; if lodged in a cerebral vessel, paralysis; or in the central artery of the retina, loss of sight in the eye implicated; if in one of the mesenteric arteries, symptoms of obstruction of the bowels, with subsequent gangrene of the intestine; if in a popliteal artery, gangrene of the leg; if lodged in the liver, spleen, or kidney, it may cause localized pain, with rise of temperature. If an embolus becomes lodged in one of the smaller vessels, where the collateral circulation is good, no serious symptoms are likely to occur. In all cases the occlusion of a vessel by an embolus causes transient or permanent ischæmia of the part supplied by the vessel occluded.

TREATMENT.—This consists largely in supporting the circulation. If the part affected is a limb, this should be elevated, kept warm, and the circulation supported by a bandage. If gangrene occurs, amputation will be necessary. Extensive intestinal resection has been successfully done for gangrene caused by either an embolus or thrombus in the mesenteric vessels.

ARTERIAL VARIX OR PLEXIFORM ANGIOMA.

This consists in the elongation and dilatation of an artery of medium or small size. The vessel is tortuous and sacculated. The superficial tem-

poral, occipital and posterior auricular are most frequently affected. The condition, however, is rare (Fig. 158).

TREATMENT.—The vessels may be exposed at their extremities, where the walls seem normal, double ligated, and resected.

CIRSOID ANEURYSM.

By this is meant the dilatation and elongation of all the vessels of a part, the process most frequently occurring upon the head, in connection

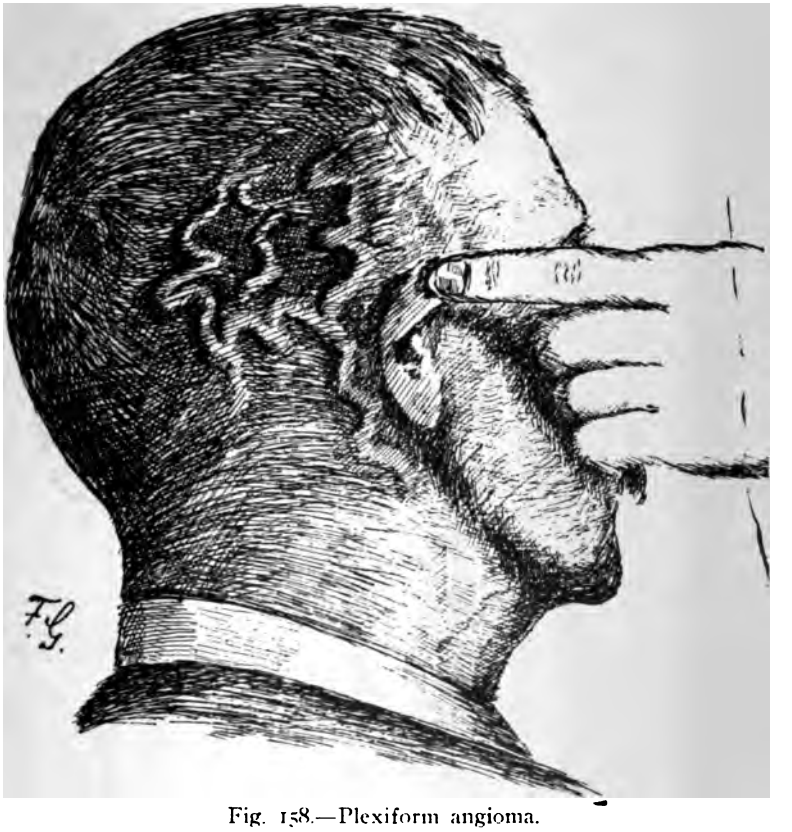


Fig. 158.—Plexiform angioma.

with the temporal vessels, but it also occurs upon the fore-arm, wrist, leg and buttocks. In this lesion there are a number of enlarged and tortuous arteries and veins bound together by connective tissue, producing an elongated, irregular, pulsating tumor.

TREATMENT.—The most successful treatment of cirsoid aneurysm seems to have been to ligate the afferent and efferent vessels where the coats are healthy, and then resect the mass.

ANEURYSM.

An aneurysm may be defined as a tumor containing blood and communicating directly with the lumen of an artery.

Aneurysms may be divided into idiopathic and traumatic.

In the idiopathic the sac is formed of one or more of the coats of the vessel. In the traumatic the sac is formed by the laminated blood clot and inflammatory exudate, and is supported by the tissues of the part.

Idiopathic aneurysms are divided into

1. Tubulated.
2. Sacculated (true and false).
3. Dissecting.

The tubulated aneurysm is one in which all three coats of the vessel are dilated and the vessel elongated. This aneurysm is found in the cranium, thoracic and abdominal cavities. The tubulated aneurysm seldom reaches any considerable size, rarely ruptures, and almost never contains laminated fibrin. Although seldom rupturing, it may give rise to great discomfort and pain, in consequence of pressure upon important structures (Fig. 159).

Fig. 159.—Tubulated aneurysm.

Fig. 160.—Sacculated aneurysm.

The sacculated aneurysm is one which springs from the side of an artery, the interior of which is in direct communication with the sac by an opening called the mouth. The sacculated aneurysm may be divided into true and false. The true sacculated aneurysm is one in which the three coats of the artery are expanded to make up the sac. These aneurysms are seldom larger than a good sized apple (Fig. 160). In the false sacculated aneurysm the altered internal coat covers the internal surface of the sac. The middle coat is only seen at the neck; while the principal part of the sac is made up of the surrounding connective tissue, which has undergone marked proliferation.

The dissecting aneurysm is one in which either the internal coat has given way as the result of the breaking down of an atheromatous patch, or as the result of a traumatism. In either of these conditions the blood makes its way between the internal and external coats and, after burrowing for a considerable distance, may break through a weak spot in the external coat and extravasate into the adjacent tissues, or it may again enter the lumen of the artery in consequence of a second weak point in the internal coat.

In other cases the blood is confined in a sac of the middle coat (Fig. 161)

COMPONENT PARTS OF AN ANEURYSM.—These are the sac and its contents. The sac, except in traumatic aneurysm and in cases which have ruptured, is composed of one or more of the coats of the vessel. The sac during the first stages of an aneurysm is ordinarily thin. The mouth of the sac is the narrow opening connecting the sac with the lumen of the artery. In the fusiform or tubulated aneurysm there is no mouth. The contents

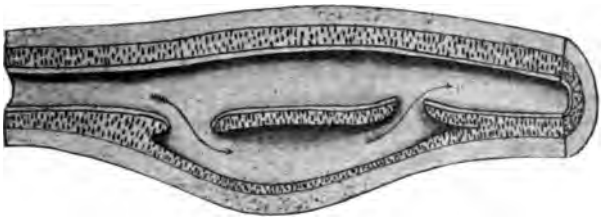


Fig. 161.—Dissecting aneurysm.

of the sac varies according to the stage of the disease. During the first stage the contents is fluid, but later, in consequence of the formation of layers of fibrin, it becomes in part or largely solid. These laminæ of fibrin are hard, dry and brittle externally, while, as one approaches the center of the sac, they become progressively softer, and in the center the contents is fluid. The deposit of fibrin depends largely upon the relation of the mouth of the vessel to the sac. If the mouth is small and so situated that the blood does not either readily enter or find its escape, it will clot in the sac and form laminæ. In the tubulated or fusiform aneurysm, where a sac is absent and the blood not retarded, laminæ are not formed (Fig. 162)

Fig. 162.—Laminated coagulum in sac

THE NATURAL TERMINATIONS OF AN ANEURYSM.—The natural terminations are (1) spontaneous cure, (2) death. A spontaneous cure may be effected by the progressive formation of laminæ within the sac until it becomes filled and the sac obliterated. A cure may be effected in consequence of a portion of a blood clot being washed out into the efferent artery and occluding it, thus arresting the circulation within the sac.

An aneurysm may cause the death of a patient in one of several ways. First, by rupture of the sac. The aneurysm approaches the surface of the

body, or some mucous or serous cavity, and, in consequence of its constant enlargement, finally ruptures.

Methods of rupture. When the sac reaches the surface of the body or a mucous membrane and makes pressure upon these structures, a small portion of the skin or mucous membrane becomes necrotic, gives way finally and a hemorrhage occurs. This may not be very severe, and as soon as the blood pressure is lowered a clot forms within the rent, arresting the bleeding. When the blood pressure is restored the clot is forced away and the hemorrhage recurs. This condition will be repeated again and again until the patient dies from loss of blood. When an aneurysm approaches a serous cavity, as the pericardial, pleural, or peritoneal, and makes sufficient pressure, the serous membrane gives way as a rent. This is often large and the patient frequently dies at once.

An aneurysm may destroy life by pressure upon important organs, as the œsophagus, thoracic duct, trachea, bronchi, and lungs. In consequence of this pressure, inanition or asphyxia may be produced. An aneurysm may produce such pressure upon the vertebræ as to cause their absorption, and subsequently press upon the cord producing partial or complete paralysis of the lower extremities.

An aneurysm may destroy life in consequence of an infection of the sac and the development subsequently of septicæmia or pyæmia. Or life may be destroyed by the detachment of a portion of a clot which, as an embolus, enters one of the cerebral or pulmonary vessels. An embolus may lodge in one of the large vessels of an extremity, causing gangrene and death by septicæmia.

CAUSES OF ANEURYSM.—These are (1) predisposing, (2) exciting.

Predisposing causes. Degeneration in the coats of the vessel excited by syphilis, alcoholism, gout, rheumatism, or lead poisoning is probably the most frequent cause. Hypertrophy of the heart may by driving the blood forcibly into the vessels cause an aneurysm. Violent occupations, or forced muscular exercises may, by increasing the blood pressure, cause dilatation of a blood vessel at some weak point and thus an aneurysm.

Age and sex. Aneurysm is more frequent between the ages of thirty and forty, while seven out of every eight cases occur in men. Age and sex speak more for forced muscular exercise as a causative factor than they do for degeneration of the coats of the vessel.

SIGNS AND SYMPTOMS OF ANEURYSM.—These may be described as occurring before and after consolidation of the aneurysmal sac.

First stage. This includes the period from the beginning of the aneurysm until the sac is obliterated by the formation of fibrinous laminæ.

In this first stage (a) pulsation is distinct and expansile and synchronous with the action of the heart. The pulsation is distinct because there is only fluid blood in the sac. The pulsation is expansile because the artery dilates in every direction. The pulsation in tumor or abscess placed over an artery is up and down and not expansile.

(b) Pressure upon the proximal vessel causes the pulsation in the sac to disappear, then the contents can be pressed out and the sac made flaccid. Pressure upon the efferent vessel causes for a time the pulsation to become

more pronounced and the sac more tense. Then pulsation ceases, but the blood cannot be pressed out of the sac.

(c) *Bruit.* This the most characteristic symptom of aneurysm. It is a rasping, whizzing, purring noise heard with each contraction of the heart and caused by the current of blood rushing into and out of the sac.

(d) The pulsation in the vessel beyond the sac is usually appreciably delayed, in consequence of the blood requiring a fraction of time to enter and emerge from the sac.

(e) Pain is often severe from the pressure of the sac upon adjacent sensitive nerve trunks.

(f) Œdema in the limb below the site of the aneurysm is frequent, in consequence of the pressure produced by the sac upon the adjacent vein.

(g) Gangrene in an extremity may result from an embolus or the pressure of the sac. Pressure upon the recurrent laryngeal nerve produces a hoarse metallic cough, termed the "brassy" cough of aneurysm. If pressure is upon the phrenic nerve hiccough may be produced. Any structure which is severely pressed upon will be either injured or destroyed.

DIAGNOSIS.—The diagnosis will be made before consolidation by considering the expansile pulsation, the pressure effects above and below the aneurysm, the delayed pulsation in the distal vessel, and the bruit.

After consolidation, diagnosis is made by considering the history, carefully examining the tumor for slight pulsation or bruit, and perhaps introducing a hypodermic needle. An aneurysm must be differentiated from a gland overlying a vessel, from an abscess, from pulsating encephaloid tumors, and from soft vascular sarcomatous growths.

DURATION.—The course of an aneurysm may be rapid and lead to rupture and the death of the patient in a few months. As a rule, however, an aneurysm runs a slow course, extending over one or more years.

TREATMENT.—The purpose of treatment is to secure, if possible, obliteration of the sac, or at least to interrupt its rapid growth. Rest is one of the most effective means for this purpose. The patient is put to bed and confined on a light diet, so as to reduce the force and number of heart beats. This method was first advocated by Tufnell in 1875. The rest should be continued for from three to six weeks. This treatment has been in many cases a prominent factor in securing the consolidation of the aneurysm.

Surgical Treatment. This has been divided as follows: First, compression; second, surgical operations; third, miscellaneous methods of treatment.

Compression has been practised in cases of traumatic aneurysm for more than two hundred years. It was formerly made over the sac. At the present time pressure, when practicable, is employed with rest. The pressure, however, is made at some distance above the sac, where the walls of the vessel are presumably healthy. The intent of the treatment is to lessen the force of the blood current in the sac, but not necessarily to interrupt it.

Compression may be made with an ordinary tourniquet. The point where pressure is to be applied should be washed with soap and water, swabbed with alcohol, and have dusted upon it some soothing powder, over

which a piece of chamois skin is placed. The strap of the tourniquet is then put about the limb and the pad screwed down until the circulation is almost, but not quite, arrested in the distal vessel. The pressure has to be continued for from one to several days.

Digital Compression. This method requires a relay of assistants, one after another making pressure with the finger over the afferent vessel. Pressure may also be practised by hanging a bag of shot from the ceiling by a piece of rubber tubing, allowing the bag to rest with sufficient force upon the vessel to be compressed. Pressure may be made upon an aneurysm situated at the bend of the elbow or at the popliteal space by flexing the extremity upon the sac.

Enlargement and pulsation in the collateral vessels takes place when the sac has been obliterated. Compression is contraindicated in large sacs, in consequence of their liability to rupture in cases of marked distal œdema and where the sac is inflamed.

Rapid Cure. (By the application of Esmarch's elastic bandage.) The idea in this treatment is to produce a blood-clot in the sac and in the afferent and efferent vessels, in contradistinction to the formation of fibrin in circulating blood. To accomplish this result the circulation in the sac must be arrested. The treatment is contraindicated if the sac be inflamed. The technic of the treatment is as follows: The patient is given a hypodermic of morphine and just enough anæsthetic to relieve the pain during the continuance of the treatment. An elastic bandage is then applied firmly from the extremity of the limb upwards to the sac, then lightly over the sac, and firmly above the sac. The bandage is kept on the limb for one hour, and just before its removal a tourniquet is applied to the afferent vessel, so as to moderate the circulation through the limb after the removal of the bandage, and prevent, if possible, its washing the clots out of the sac. The tourniquet is kept in place for from sixteen to twenty-four hours. The risks of this method of treatment are, first, the washing out of blood clots; and second, gangrene of the limb from too prolonged application of the bandage. In a number of cases the treatment has resulted in a cure.

In cases in which rest and compression fail, operative measures should be resorted to.

Ligation. The method of Antyllus was practised from the fourth to the eighteenth century, and consisted in exposing and ligating the artery immediately above and below the sac. The aneurysm was then laid open, the clots turned out, and the sac filled with myrrh. The risks of this operation were that the coats of the vessel immediately above and below the sac were usually diseased, and also that suppuration became established, both favoring the loosening of the ligatures and the occurrence of secondary hemorrhage.

Anel in 1710 operated successfully by ligating the proximal vessel just above the sac. Anel's operation was a great improvement over Antyllus' in that the sac was not disturbed, and the vessel ligated in but a single place.

In 1785 John Hunter worked out a plan, which consisted in tying the main vessel at a considerable distance above the sac, where the coats of the

to cut off all of the circulation coming to the aneurysm, but only to diminish artery were presumably healthy. Hunter reasoned that it was not necessary its volume and force. The Hunterian method was immediately adopted, and has been practised up to the present time. The accidents which may follow the Hunterian operation are secondary hemorrhage, return of pulsation,

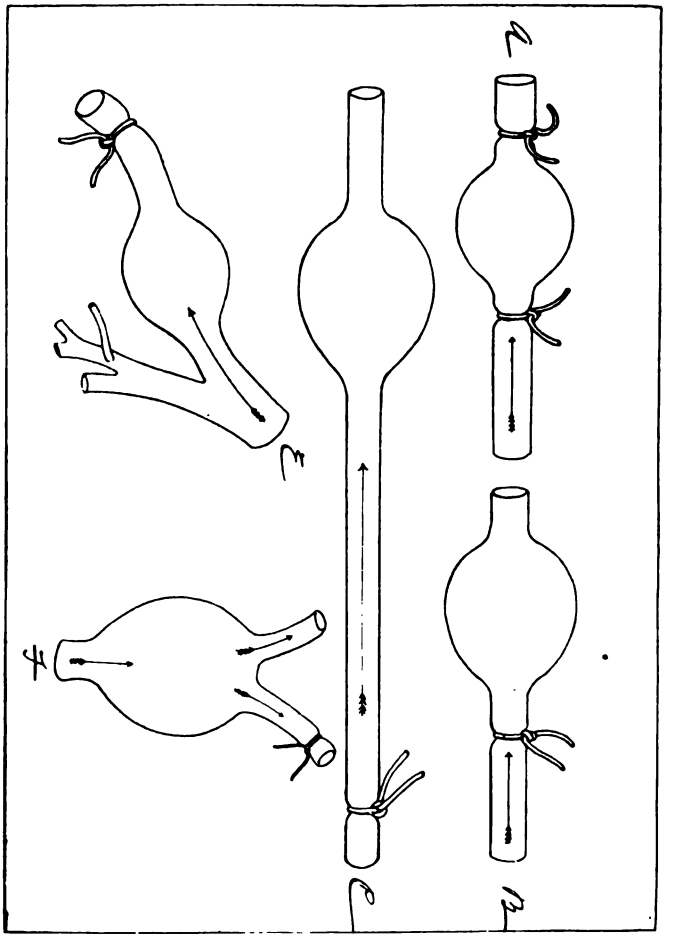


Fig. 163.—A.—Antyllus' method. B.—Anel's method. C.—John Hunter's method. E.—Brasdor's method. F.—Wardrop's method.

gangrene of the extremity, suppuration, septicæmia and pyæmia. While any of these accidents may occur, none is to be expected.

Brasdor's Operation. This operation consists in ligating the artery on the distal side of the sac. As the result of distal ligation the circulation in the sac, after a short period of time, becomes arrested. This operation may be practised in cases in which it is impracticable or not wise to ligate the proximal vessel, as in aneurysms of the first portion of the carotid and subclavian arteries.

Wardrop's Operation. Wardrop's operation consists in ligating one of two distal branches, as in ligating the common carotid in aneurysm of the innominate, or the external carotid in aneurysm of the common carotid.

Matas' Method of Arteriorraphy for the Radical Cure of Aneurysm. The method as applied to a sacculated aneurysm comprises the following steps:

First. The efferent and afferent vessels are exposed and proximal and distal temporary ligatures applied.

Second. The sac is opened and its contents removed.

Third. The opening or openings into the sac are then closed by interrupted or continuous chromicized catgut sutures.

Fig. 164.—Matas' method of arteriorrhaphy.

Fourth. Removal of the temporary ligatures and testing of the suture line.

Fifth. Obliteration of the aneurysmal sac by tier sutures.

Quite a large number of cases have now been successfully treated by this method. Its advantages are that it preserves the lumen of the vessel.

In order to attain success, the walls of the vessel at the mouth of the opening must be in a reasonably healthy condition.

Miscellaneous Methods. There are a variety of these methods which

Amputation. Amputation may be required in cases of gangrene of the limb, for suppuration of the sac, in cases of secondary hemorrhage where a joint has been destroyed, and where mere conservative methods have failed.

TRAUMATIC ANEURYSM.

By this is meant an aneurysm which is due to an injury. This injury may have been a dislocation or strain, in consequence of which some one or more of the coats of the vessel have given way; it may have been a fracture with the thrusting of a spicule of bone through an important vessel. It is usually due to some foreign substance which has penetrated the parts and partially divided a vessel. This foreign substance may have been a bullet, a knife, a piece of glass, or a bit of tin or steel, or any other foreign substance which could have been driven into the tissues with decided velocity.

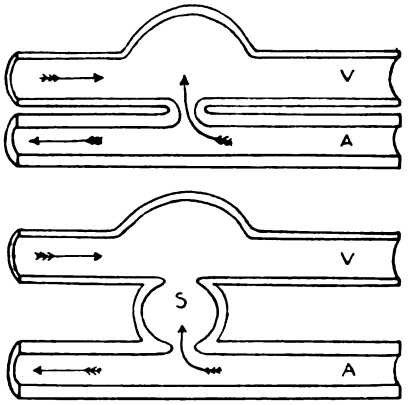


Fig. 165.—A.—Aneurysmal varix. B.—Varicose aneurysm.

A traumatic aneurysm differs from an idiopathic aneurysm in that the coats of the vessel are usually healthy. With the injury to the vessel the blood escapes into the surrounding structures. If these are dense the amount of blood escaping will be very slight; if the tissues are loose a much greater quantity may escape; while if the vessel opens into a cavity the patient may bleed to death within his own tissues. The sac of a traumatic aneurysm is composed of a blood clot, supported by the surrounding structures.

DIAGNOSIS.—The diagnosis is ordinarily easy. An injury—usually a wound—and then a suddenly appearing tumor. This tumor has the characteristics of an aneurysm, pulsates, has a bruit, and is influenced by pressure above and below the sac.

TREATMENT.—An elastic bandage is applied and the limb made bloodless. The two ends of the vessel are then exposed and ligated.

ANEURYSMAL VARIX.

This condition is usually the result of a bullet or stab wound, in consequence of which an artery and vein are made to communicate, without the intervention of a sac. As a result of the opening the current of blood, at least in part, enters the vein, producing a dilatation of its walls.

VARICOSE ANEURYSM.

In this lesion the walls of an artery and vein have been opened, while the current of blood has separated the artery from the vein and produced a sac between the two vessels (Fig. 165).

SYMPTOMS.—An aneurysmal varix may exist for years without producing symptoms. The vein and artery remain in close apposition, while the coats of the vein are not seriously dilated. The blood from the artery comes in contact with the blood from the vein, producing a hoarse, wheezing noise characteristic of aneurysmal varix.

TREATMENT.—In the treatment of an aneurysmal varix all that is generally required is to place a compress and light bandage over the part. If the varix continues to increase the artery above and below the opening should be ligated.

In varicose aneurysm in consequence of the tendency of the sac constantly to enlarge, the artery both above and below the aneurysm should be exposed and ligated.

ANEURYSM OF THE INNOMINATE ARTERY.

This lesion is usually associated with aneurysm of the arch of the aorta. It presents a pulsating tumor rising above the right sterno-clavicular articulation. The pulse in the right radial and temporal arteries is diminished. The right side of the face and the right arm are often œdematous from pressure upon the right innominate vein. A shooting pain in the arm and neck is frequent, from pressure upon the cervical and brachial nerves. Hyperæmia of the right side of the face, and dilatation of the right pupil may be present from irritation of the sympathetic, as well as dyspnœa from pressure upon the trachea, and a brassy cough from irritation of the recurrent laryngeal nerve.

TREATMENT.—Rest and distal ligation of the common carotid and subclavian arteries.

ANEURYSM OF SPECIAL ARTERIES. LIGATION OF ARTERIES.

Ligation of the Common Carotid Artery. This artery extends from the sterno-clavicular articulation to the top of the thyroid cartilage. Its course corresponds to the anterior border of the sterno-cleido-mastoid muscle. The point of election for the application of a ligature is just above the omo-hyoid muscle on a level with the cricoid cartilage.

An incision three inches long is made at the anterior border of the sterno-mastoid muscle, and having its center on a line with the cricoid cartilage. The integument, superficial fascia and platysma are divided, while the lips of the wound are well retracted. The deep fascia is then lifted with two forceps and divided, care being taken not to wound the vein beneath. This will bring the sheath of the carotid artery into view, which is picked up with forceps along its internal border and divided perpendicularly for half an inch. The artery is then separated with the handle of a scalpel from the adjacent tissues, and a blunt aneurysmal needle threaded with strong silk carried about it, from without inwards, care being taken not to

injure the internal jugular vein or include the pneumogastric nerve. The silk is then drawn with sufficient firmness, so as simply to approximate the walls of the vessel without cutting through any of the coats. The ligature is then knotted, cut short and the wound closed without drainage.

Ligation of the Subclavian Artery. The ligation of this vessel is difficult, and should only be undertaken by an expert. The right subclavian arises from the innominate opposite the sterno-clavicular articulation, and passes upwards and outwards to the inner margin of the scalenus anticus muscle. This is its first portion, and from it are given off the thyroid axis, the vertebral, and internal mammary arteries. Passing in front of this first portion are the internal jugular, the phrenic and pneumogastric nerves. The second portion of the subclavian artery passes behind the scalenus anticus muscle, while the third portion extends from the outer border of this muscle to the lower border of the first rib. The third portion of the vessel is the one selected for ligation. This is largely in consequence of the large number of important structures given off or surrounding the first portion, and also in consequence of the second portion lying behind the scalenus anticus muscle.

Technic of Operation. For the purpose of avoiding the external jugular vein the integument is drawn down and an incision made over the clavicle three inches long down to the bone. The incision should extend from the external border of the sterno-mastoid to the internal border of the trapezius muscles. The platysma and cervical fascia are picked up with two pairs of forceps and divided. The suprascapular and transverse cervical veins are pulled aside, and the suprascapular artery avoided. The omohyoid muscle is held one side when the deep cervical fascia is separated with the handle of the scalpel. The subclavian artery can now ordinarily be seen as it passes beneath the clavicle to the first rib. After the artery has been separated from the surrounding structures by blunt dissection, an aneurysmal needle carrying strong silk is passed around the vessel from above downwards and inwards, being careful not to include branches of the brachial plexus or to injure the subclavian vein. The patient should be kept in bed for two weeks, and the arm elevated, bandaged and kept warm.

ANEURYSM OF THE COMMON CAROTID ARTERY.

The upper portion of this vessel is the part usually implicated. There will be a tumor, which grows slowly or rapidly, and which presents the characteristic symptoms of an aneurysm. In addition to the usual symptoms there is likely to be dyspnœa, difficult deglutition, vertigo, hoarseness, brassy cough, and ringing in the ears. In a carotid aneurysm the radial pulse is not affected, while the temporal on the corresponding side is likely to be small and perhaps appreciably delayed.

DIAGNOSIS.—This is often difficult. It will depend upon the general symptoms of aneurysm, and the special symptoms incident to aneurysm of the common carotid, together with a history of the case and a physical examination of the part.

TREATMENT.—In an aneurysm of the lower portion of the carotid the vessel may be tied in its upper portion. The technic has already been given.

In an aneurysm confined to the upper portion, proximal ligation may be done.

Technic. An incision three inches long is made down the internal border of the sterno-mastoid to the top of the sternum. A second incision is carried from the termination of the first along the clavicle for two inches. The insertion of the sterno-mastoid muscle is divided. The underlying connective tissue is separated by blunt dissection, avoiding the anterior jugular vein, and exposing the sterno-hyoid and sterno-thyroid muscles.

Fig. 166.—Aneurysm of the subclavian artery.

These muscles are drawn inwards by retractors, and the sheath of the vessel exposed. This is picked up and divided between two forceps, at its inner border; the artery is then loosened from its sheath by blunt dissection, and the aneurysmal needle carrying a strong silk thread passed about it.

Accidents which May Follow Ligation of the Common Carotid Artery. Embolism, secondary hemorrhage, cerebral softening, hemiplegia, and suppuration of the sac.

SUBCLAVIAN ANEURYSM.

This may be idiopathic or traumatic. The idiopathic variety usually occurs in the third portion of the artery. Aside from the usual symptoms

of aneurysm there is a weakened and delayed radial pulse, pain shooting down the arm from pressure on the brachial plexus, and œdema of the extremity from pressure on the subclavian vein. Pressure on the internal jugular will cause its enlargement, while irritation of the recurrent laryngeal nerve on the right side will occasion an aneurysmal cough. An aneurysm commencing in the third portion of the subclavian is quite likely to extend into the axillary and also to involve the other portions of the subclavian, and often, on the right side, the innominate artery as well. This is especially likely to occur if the aneurysm is of the tubulated variety (Fig. 166).

DIAGNOSIS.—The diagnosis of a subclavian aneurysm will depend upon the symptoms, the presence of a tumor situated above and beneath the clavicle, the delayed and weakened radial pulse, the extension perhaps of the tumor into the axilla, and the strong and equal carotid pulses.

TREATMENT.—The treatment of aneurysm of the subclavian in the third part of its course should primarily be proximal compression, and, failing in this, ligation of the axillary artery. If the axillary pulse upon the affected side is very feeble, it will be practically useless to ligate this vessel. In such a case either the second or even the first portion of the subclavian, or even the innominate artery may be ligated.

Technic—Ligation of Axillary. The arm is extended and an incision two to three inches long made from the head of the humerus to about the center of the axillary space. After dividing the axillary fascia and connective tissue, the median nerve and axillary vein are reached. The nerve is displaced outwards and the vein inwards. This exposes the axillary artery. The ligature may now be passed about the vessel and secured with a knot.

AXILLARY ANEURYSM.

The causes may be traumatic or idiopathic. Of the traumatic a stab or bullet wound may be the cause, or it may be the result of a strain or dislocation. In the idiopathic cases there is some weakness in the walls of the vessel. In the idiopathic aneurysm there will be the usual symptoms, a rapidly growing tumor in the axillary space, pains streaking down the arm, weakened and perhaps perceptibly delayed radial pulse, and œdema. If the aneurysm reaches a considerable size, it is likely from pressure to cause absorption of one or more ribs, a portion of the clavicle and chest wall. The shoulder joint may also be involved. An axillary aneurysm usually grows rapidly in consequence of the lax condition of the surrounding parts. The sac also readily becomes inflamed and frequently ruptures.

TREATMENT.—This consists primarily in proximal compression of the third portion of the subclavian artery, or if pressure fails, in ligating this portion of the artery. In cases in which this is not practicable the axillary artery may be ligated, preferably in the third portion of its course, or that portion which lies below the pectoralis minor muscle.

BRACHIAL ANEURYSM.

This may be traumatic or idiopathic. The aneurysm may be situated in any portion of the vessel. The brachial artery being very superficial, the characteristics of an aneurysm can readily be made out. The vessel may

also require ligation in consequence of wounds implicating the brachial or some of its branches.

Technic. The vessel is exposed by a short incision along the internal border of the coraco-brachialis or biceps muscles. The artery is exposed after dividing the integument, superficial and deep fascia. The internal cutaneous and ulnar nerves lie internal, the median nerve to the outside, or often in front, and the venæ comites on either side. These structures having been separated by blunt dissection the aneurysmal needle is passed about the vessel from within outwards and the vessel ligated.

Ligation of the Radial Artery. This may be required in case of aneurysm or wounds of the radial or some of its branches. In its upper third the vessel is quite deep, being covered by the integument, superficial and deep fascia, and overlapped by the supinator longus muscle. In the lower two-thirds of its course it is superficial. When exposing the vessel the arm should be supinated with the palm up and an incision two or three inches long made at the internal border of the supinator longus muscle. In the upper third the incision should be on a line drawn from the center of the bend of the elbow to the styloid process of the radius. In the middle and lower thirds the vessel is exposed by an incision along the internal border of the tendon of the supinator longus muscle. In the middle third the radial nerve lies on the outside of the artery. The artery should be separated from the venæ comites by blunt dissection, and the aneurysmal needle passed about it from without inwards.

Ligation of the Ulnar Artery. This may be required for aneurysm or a wound of the vessel or some of its branches. The upper portion of the vessel is deeply situated beneath the superficial flexor muscles. The lower portion is superficial. To reach the vessel in the lower portion of the upper third, the forearm should be supinated, and an incision made in the course of a line extending from the front of the internal condyle of the humerus to the pisiform bone. The integument and superficial fascia are divided and the flexor carpi ulnaris separated from the other flexor muscles, and drawn inwards. The ulnar nerve will be seen outside of the ulnar artery. The artery is freed from its veins and ligated. The middle and lower thirds of the ulnar artery are very superficial. Upon the ulnar side is the flexor carpi ulnaris, the ulnar nerve being upon the inside and close to the artery. A short incision is sufficient to expose the vessel, when it is separated from the venæ comites and ligated.

Superficial Palmar Arch. This vessel may require ligation in consequence of a wound. The arch is formed by the continuation of the ulnar across the palm of the hand. It usually anastomoses with the superficialis volæ of the radial to complete the arch. Its situation is represented by a line drawn transversely from the web of the thumb across the palm of the hand. The superficial palmar arch is covered by the integument, palmar fascia, and the palmaris brevis muscle.

Technic. The hand and wrist should be rendered bloodless by the application of an Esmarch bandage, when a transverse incision two inches long is made across the palm of the hand, following the above mentioned line. The integument, palmar fascia, and palmaris brevis muscle are divided, when the ends of the vessel are exposed and ligated. If the ves-

sel is not readily found, the bandage may be slightly loosened so as to identify the ends of the vessel by the bleeding.

Deep Palmar Arch. This is formed by the terminal part of the radial anastomosing with the deep branch of the ulnar. It is situated one-half to three-quarters of an inch above the superficial palmar arch. The arch

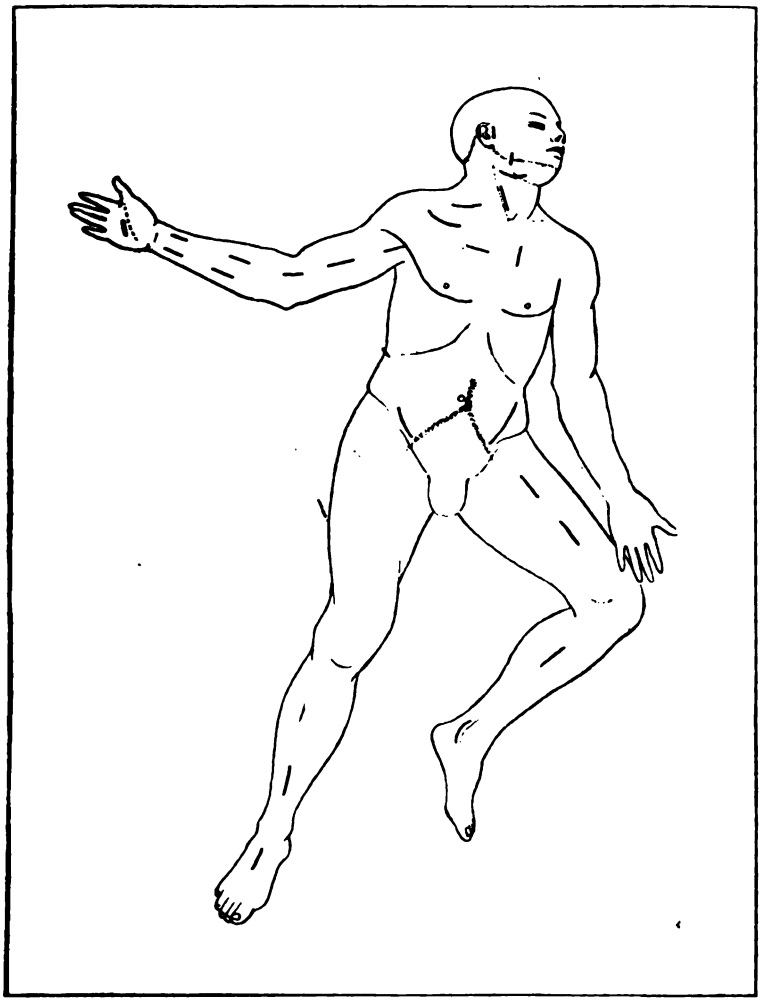


Fig. 167.—Outlines of arterial system.

extends from the base of the metacarpal bone of the little finger to the upper end of the first interosseous space. The arch lies deep in the palm, in contact with the base of the metacarpal bones and ligaments. It is covered by the flexor tendons of the fingers and the flexor brevis pollicis.

Ligation. The hand is rendered bloodless by the application of the Esmarch bandage, when a transverse incision is made across the palm at the base of the metacarpal bones. The nerves and flexor tendons must be carefully avoided. The bleeding vessel may be located either by following the original wound or, when in deep tissues, occasionally loosening the constriction so as to be guided to the vessel by the bleeding.

Ligation of the External Carotid. This vessel extends from the top of the thyroid cartilage to the space between the neck of the condyle and the external auditory meatus. The vessel is placed in a triangle, bounded by the sterno-mastoid behind, the omo-hyoid below, and the posterior belly of the digastric and stylo-hyoid above. It is covered by the integument, platysma, deep fascia, and anterior margin of the sterno-mastoid. It is crossed by the hypoglossal nerve and by the lingual and facial veins. It may be necessary to ligate the external carotid in case of wounds of the vessel or some of its branches, and in cases of pulsating tumor of the face or side of the head. An incision about three inches long is made over the anterior border of the sterno-mastoid and extending from the angle of the jaw to the cricoid cartilage. The skin, platysma, and deep fascia are divided, the hypoglossal nerve and deep veins drawn aside, and the vessel ligated.

Superior Thyroid. This is the first branch given off from the external carotid. Branches of this vessel are often divided in attempts at suicide. The artery can usually readily be reached by enlarging, if necessary, the original wound. The vessel may be ligated at its origin by making a short incision along the anterior border of the sterno-mastoid with its center corresponding to the top of the thyroid cartilage. The skin, superficial fascia, platysma and deep fascia are divided, and the sterno-mastoid drawn backwards when the superior thyroid will be visible, crossing the floor of the superior carotid triangle, where a ligature may readily be passed about the vessel.

Lingual Artery. This is the second branch given off from the external carotid. It runs upwards and inwards to the great cornu of the hyoid bone, then passes horizontally forwards, and finally ascends perpendicularly to reach the under surface of the tongue, which it supplies under the name of the ranine artery. The vessel is tied by making an incision from near the symphysis of the jaw downwards to the cornu of the hyoid bone, and then upwards to near the angle of the jaw. The skin, superficial fascia, platysma, and deep fascia are divided, exposing the submaxillary gland, which is pulled upwards by a dull retractor. The digastric triangle is now exposed, and stretching across the upper part of its floor is the hypoglossal nerve, while half an inch or so below the nerve is the ranine vein. The muscle is lightly divided between the nerve and vein, when the artery bulges into the incision and is readily secured.

Facial Artery. This vessel may be ligated as it crosses the inferior maxillary bone. An incision an inch long is made in front of the anterior border of the masseter muscle, directly over the line of the artery. The skin, fascia, and platysma muscle are divided. Before making the incision the skin should be drawn upwards so that when the parts are at rest the scar will fall below the jaw.

Internal Carotid. This extends from the bifurcation of the comm carotid at the upper border of the thyroid cartilage to the carotid foram in the petrous portion of the temporal bone. This vessel supplies the an rior part of the brain, the eye and its appendages, and sends branches the forehead and nose.

Ligation of the internal carotid may be required in stab or bul wounds of the vessel, and for an aneurysm of some one of its branch In penetrating wounds of the orbit the ophthalmic artery has been occ sionally injured, followed by the formation of an aneurysm. The incisi for ligating the internal carotid is the same as that for ligating the extern carotid. The skin, superficial fascia and deep fascia are divided, and t thyroid, laryngeal, lingual and facial veins avoided or double ligated a divided. The sterno-mastoid muscle is drawn backwards, and the hyp glossal nerve avoided as it winds about the occipital artery. The arter which lies external to and behind the external carotid, is then exposed, a the aneurysmal needle passed about it from without inwards, care bei taken not to injure the internal jugular vein or the pneumogastric nerve.

Gluteal Artery. This vessel may require ligation in consequence of wound or an aneurysm. The vessel is a branch of the posterior trunk the internal iliac artery, and emerges from the pelvis above the pyriform muscle at the upper part of the great sacro-sciatic foramen. The artery c be ligated not far from where it emerges from the pelvis. The surface gui is a line drawn from the posterior superior spinous process of the ilium the middle of the great trochanter. The junction of the upper and midd thirds of this line crosses the artery at an acute triangle. An incision made along this line, its center corresponding to the junction of the upp and middle thirds of the line. The skin and fascia are divided, the fibe of the gluteus maximus and medius separated, when at the bottom of t wound the artery can be felt and ligated.

Sciatic Artery. This vessel is a branch of the internal iliac and leav the pelvis through the great sacro-sciatic foramen below the tendon of t pyriformis muscle. The artery descends between the tuberosity of t ischium and the great trochanter of the femur. The surface guide is line drawn from the posterior superior spine of the ilium to the extern border of the tuberosity of the ischium. At the junction of the lower an middle thirds an incision three inches long is made directly across the lin The skin and fascia are divided and the fibers of the gluteus maximu separated. At the bottom of the wound are situated the sciatic artery, an the lesser and greater sciatic nerves. Avoiding the nerves the artery ca readily be ligated.

Femoral Artery. This vessel may require ligation for an aneurysm o the femoral or popliteal artery, or in consequence of a wound of the femor or one of its branches.

The aneurysm may be traumatic or idiopathic.

In traumatic aneurysm the tourniquet should be applied well abov the sac. The sac is then laid open, the clots turned out, and both ends o the vessel secured. In idiopathic aneurysm proximal compression shoul first be tried, and, failing in this, a proximal ligation should be done upo the femoral or external iliac.

A popliteal aneurysm is usually idiopathic and can be treated, if the sac is not inflamed, by flexing the leg well up on the thigh, or by proximal compression, or ligation.

Ligation of the Femoral Artery. The surface guide is represented by a line which extends from midway between the anterior superior spinous process of the ilium and the symphysis pubis to the internal surface of the internal condyle of the femur. The femoral may be ligated in any part of its course, although from three to five inches below Poupart's ligament is considered the most favorable site. The muscular guide is the internal border of the sartorius. An incision is made beginning three inches below Poupart's ligament and extending downwards three inches. The integument, superficial and deep fascia are divided. The internal saphenous vein lies upon the inside of the incision. The sheath of the femoral vessels is placed just under the sartorius muscle. The sheath of the vessel should be opened upon its outer side and the aneurysmal needle passed from within outwards.

Popliteal Artery. This vessel extends from the femoral opening in the adductor magnus muscle to the lower border of the popliteus muscle. The artery lies on the posterior surface of the internal condyle, the posterior ligament of the knee joint and the popliteus muscle. The vein and the internal popliteal nerve are superficial to the artery, the nerve often crossing the artery near the center of the popliteal space. The vessel is preferably ligated in the upper part of the space. The incision should be about three inches long and extend through the center of the space. After dividing the skin and fascia, considerable connective tissue and fat will have to be separated, when the internal popliteal nerve will be seen, and just internal to this the vein, which is somewhat external to, but slightly overlaps, the artery. The vein and nerve are drawn outwards and the ligature passed from without inwards.

Posterior Tibial Artery.—This vessel arises at the bifurcation of the popliteal and extends down the back of the leg to a point between the internal malleolus and the tuberosity of the os calcis. The artery in its course down the leg is covered by the superficial muscular layers of the calf of the leg. It may be reached through either one of two routes. First, an incision four to five inches long is made posteriorly in the center of the calf dividing the skin and superficial fascia. The gastrocnemius and soleus are divided by blunt dissection and the deep fascia incised. This exposes the vessel when it may be ligated. Or an incision may be made just behind the tibia, the internal saphenous vein avoided, and the attachments of the soleus divided. The soleus is then lifted, the deep fascia divided, and the vessel exposed and ligated. The nerve is external to the artery.

Anterior Tibial Artery. This vessel is given off from the popliteal at the lower border of the popliteus muscle. It passes forwards between the tibia and fibula and just above the interosseous membrane it descends to the bend of the ankle, where it is superficial and becomes the dorsalis pedis. The vessel in the upper part of its course is deeply situated, but may be ligated by making an incision which commences from three to four inches below the head of the tibia and extends downwards external to the border of the tibialis anticus and the crest of the tibia for about three inches. The

skin and fascia are divided, as well as the intermuscular septum wh connects the tibialis anticus with the extensor longus digitorum. Th muscles are separated when deep down at the bottom of the wound, a on the interosseous membrane may be felt the artery, where it may be cured. The wound must be well retracted during the operation. T artery has on its outer side the anterior tibial nerve and is accompanied the venæ comites. For the purpose of tying the vessel in the lower p of its course, an incision three inches long may be made three-quarters an inch external to the crest of the tibia. The integument and fascia be divided, the tibialis anticus is separated from the extensor proprius polli when the anterior tibial vessels are seen, the nerve superficial and art lying upon the tibia, with a vein upon either side. The nerve and veins separated from the vessel, and the artery ligated.

The Dorsalis Pedis Artery. This vessel is a continuation of the ante tibial. It passes forwards from the bend of the ankle to the back part the first interosseous space, where it divides into two branches, the dors hallucis and the communicating artery. The pulsation of the artery n be readily felt and the vessel secured by making an incision two inches l on the outer side of the extensor proprius pollicis. The fascia being divid the artery will be exposed, with the nerve upon its outer side.

CHAPTER XI.

SURGICAL AFFECTIONS OF THE NERVES.

STRUCTURE OF THE NERVES.

The peripheral nerves are peculiar in that they are without a bony covering. Consequently they are frequently injured. The peripheral nerves are formed by the collection of nerve fibers into bundles known as funiculi, and are surrounded by a connective tissue sheath known as the perineurium. Several bundles are again bound together by a fibrous sheath to form a nerve. This sheath is known as the epineurium.

THE HISTOLOGY OF A NERVE FIBER.—Every nerve fiber is made up (1) of an axon, or axis-cylinder; (2) a medullary sheath; (3) the sheath of Schwann, or neurilemma. The axis-cylinder is apparently the essential part of the nerve fiber. The myelin or medullary sheath is of a whitish color and composed largely of fat and water, and makes up the greatest part of the nerve. The medullary sheath is interrupted at certain regular intervals by constrictions, which are known as the nodes of Ranvier. The neurilemma, or sheath of Schwann, is a delicate membrane having a prominent nucleus for each internode.

Nerves are supplied with blood vessels which penetrate the epineurium, pass between and into the funiculi and break up into capillaries, which surround the individual nerve fibers. Lymphatic spaces are not known to be present in the nerve internal to its sheath.

NEURITIS OR INFLAMMATION OF A NERVE.

The causes of neuritis have been divided into (1) traumatic, (2) toxic, (3) cachectic. Under the second class are included such substances as alcohol, lead, arsenic, mercury, zinc, copper, phosphorus, and carbonic acid, as well as the toxic products of acute infectious fevers. Under the third division are included those due to diabetes, rheumatism, gout, cancer, and arterio-sclerosis.

Neuritis has been divided into the acute and chronic cases; pathologically into the parenchymatous and interstitial.

The acute cases are usually due to infectious diseases, alcohol, or pyogenic infection. In these the axones and medullary sheaths are the seats of the greatest changes. These structures are broken up, and partially disappear, the neurilemma, with an increased number of nuclei, remaining.

The interstitial or chronic form is frequently traumatic, due to a cold, rheumatism, overwork, or debility. In the chronic cases the inflammatory process affects principally the connective tissue of the nerve, which is primarily infiltrated, the infiltrate subsequently being converted into connective

CLINICAL COURSE OF ACUTE NEURITIS.—There is pain, local sensitiveness, a swelling of the nerve, with fever, and quickly occurring paresis or paralysis of the parts which are supplied by the affected nerve. Acute neuritis is a comparatively rare disease.

CHRONIC NEURITIS.

This is a very frequent condition. It is often the consequence of anæmia, overwork, care, loss of sleep, and debility in young women. The process comes on gradually, the patient feeling debilitated, while there is an aching pain in an extremity, usually an arm, or in both arms, with numbness and weakness. The patient is unable to use the affected member to any extent. If the inflamed nerves are pressd upon they are found to be sensitive. There is seldom any rise of temperature.

DIAGNOSIS.—The process is to be differentiated from neuralgia by the absence of paroxysms of pain, and from rheumatism by the natural condition of the joints and muscles, the absence of fever, and the sensitiveness of the nerve. The prognosis is almost always good.

TREATMENT.—First, the cause if possible should be corrected. This may be the use of alcohol, mercury, lead, phosphorus, or other exogenous substances. The second important consideration is rest. The affected nerve should have absolute rest. If the inflammation is marked and the part affected an arm, this should be put in a sling; if the inflamed nerve is in a lower extremity the patient should be put to bed; worry should be relieved, sleep encouraged, nourishing food administered, and the hygienic surroundings of the patient if possible improved.

Tonics are nearly always indicated, such as quinine, iron, arsenic, and nux vomica. These may be made very conveniently into a pill, with taraxacum. Galvanism is also beneficial in this class of cases, and may be applied once each day.

NEURALGIA.

This may be described as an acute paroxysm of pain extending throughout the area of distribution of a sensitive nerve.

The causes of neuralgia are cold, malaria, anæmia, acute rheumatism, and syphilis. Persons of a neurotic temperament, especially when debilitated and anæmic, are likely to suffer from neuralgia. In some cases the nerve is the site of an inflammatory process.

TIC DOULOUREUX.

This form of neuralgia is usually confined to the fifth nerve. It is characterized by the paroxysms coming on suddenly, having great intensity, and lasting for but a few moments. The process often appears in the supra-orbital, infra-orbital, temporal, and inferior maxillary branches of the fifth nerve. The paroxysm may be brought on by anything which will cause nervous irritation, such as the slamming of a door, a gust of wind, attempting to speak, to eat, or to enter into conversation. The pain is of such severity that the patient ordinarily ceases, if speaking, puts his hand up to the side of his face as if to protect it rather than to make pressure upon it; often opens the mouth and moves the tongue backwards and forwards as if to cool the parts; while the muscles of the face are frequently contracted

and the affected side of the face contorted. A paroxysm lasts for but a moment or two and then disappears, when the patient resumes his former occupation. The paroxysm may return every half hour, or perhaps not for several days.

DIAGNOSIS.—The diagnosis is ordinarily easy. The pain is nearly always situated in some branch of the fifth nerve, comes on in short paroxysms of the greatest severity, which lasts but for a moment or two and then disappears.

TREATMENT OF NEURALGIA.—The cause if possible should be corrected. If the patient is anæmic he should be given iron; if he has malaria, quinin; if suffering from syphilis, mercury or potash. Nearly all persons suffering from neuralgia are anæmic and more or less debilitated, and should be given as a rule quinin, iron, arsenic and strychnin. Quinin may be given in five grain doses two or three times a day; strychnin in gradually increasing doses up to one-twentieth, one-fifteenth or perhaps one-tenth of a grain three or four times a day, or until there are muscular twitchings. The part should also be protected from cold and dampness. Galvanism is often serviceable. The diet should be full and contain a quantity of fat-producing foods.

In cases of severe and inveterate neuralgia in which internal medication, dry heat and galvanism are of no avail, nerve stretching—neurectasy—is often of signal service. This treatment may be applied to any of the accessible nerves, but is most frequently resorted to in severe cases of sciatic neuralgia. The sciatic nerve is readily exposed by an incision three inches long just below the gluteus maximus muscle and midway between the biceps and vastus externus. After dividing the skin and fascia the connective tissue is separated by blunt dissection and the nerve readily exposed. The nerve is stretched by hooking one or two fingers under it and making steady but very strong traction upwards for from two to three minutes. After resting a moment the process may be repeated. The nerve will stand all the traction that a strong man can make with one or two fingers. The force necessary to rupture the sciatic nerve varies from eighty-six to two hundred pounds in the cadaver. Stretching breaks up adhesions, changes the nutrition of the nerve, and for a time paralyzes sensation. The relief of pain is immediate and usually permanent.

NEUROTOMY, OR DIVISION OF A NERVE, AND NEURECTOMY, OR EXCISION OF A NERVE.

These two operations may be considered together. They have both been extensively resorted to in cases of severe neuralgia. Neurotomy for pain in a sensitive nerve is very seldom done at the present time. Neurectomy, or evulsion, is frequently employed, especially in cases of severe neuralgia of one or more branches of the fifth nerve. The supra-orbital nerve is a branch of the ophthalmic, or first division of the fifth, and reaches the face through the supra-orbital foramen or notch. This foramen is situated at the junction and inner and middle thirds of the eyebrow. In cases of inveterate supra-orbital neuralgia which has resisted internal medication, the supra-orbital nerve may be avulsed through a curvilinear incision one inch in length in the eyebrow. The nerve is seen as a white

thread emerging from the supra-orbital notch. It is seized with artery forceps, divided peripherally, separated as far back of the notch as possible, and then twisted or torn out. If the nerve passes through a foramen the bridge should be chiseled away. The wound is closed with a cat-gut strand.

INFRA-ORBITAL NEURALGIA.

The infra-orbital nerve is a branch of the superior maxillary, and reaches the face through the infra-orbital canal. In cases of inveterate neuralgia of the fifth this branch is frequently involved. The nerve may be exposed by making an incision one inch in length just beneath the orbital surface of the superior maxillary and over its inner third. The deeper tissues are carefully divided down to the foramen, from which the nerve is seen making its exit. The foramen should be opened by cutting away the bridge of bone with a chisel and the canal broken open on the floor of the orbit. The nerve is then seized with artery forceps, divided peripherally, lifted out of its canal as far back as is possible, twisted and avulsed.

INFERIOR DENTAL NEURALGIA.

In cases of intractable neuralgia of this nerve it may be exposed by making an incision beginning just behind the angle of the jaw and extending forwards for two inches. The incision is then displaced upwards and one and one-quarter inches above the angle, the masseter muscle separated from the ramus for a short distance and a half-inch trephine applied. The removal of a button of bone in this position exposes the nerve as it enters the inferior dental canal. The nerve is then hooked up and avulsed.

The Use of Osmic Acid in Cases of Inveterate Neuralgia.—This treatment in cases of tic douloureux has become to some extent popularized in this country by the work of Dr. J. B. Murphy. It is claimed that the injection of osmic acid produces a condition of atrophy in the nerve which is not followed by regeneration, and that the results are more permanent than they are following avulsion or neurectomy. The treatment may be carried out either with or without an incision. The nerve indicated may be exposed by an incision, when from five to ten drops of a one per cent. solution of osmic acid in water are injected into the nerve and surrounding structures. Without incision the location of the nerve is determined and the same injection carried as nearly as possible into the nerve and surrounding structures.

REMOVAL OF THE GASSERIAN GANGLION.

In cases of persistent neuralgia of some one or more branches of the fifth nerve which has resisted all of the ordinary methods of treatment, the Gasserian ganglion may be removed. The ganglion rests upon the anterior surface of the apex of the petrous portion of the temporal bone. It may be reached by turning down a large osteoplastic flap from the temporal region, separating the dura and lifting the brain with a long flat retractor. The dura is separated along the anterior surface of the petrous portion of the temporal bone and in the middle fossa until the inferior maxillary nerve as it passes to the foramen ovale is reached, being careful not to rupture the middle meningeal artery as it emerges from the foramen spinosum. The

superior maxillary nerve as it passes to the foramen rotundum is then identified, and these two nerves drawn upon and divided close to their foramen, when they are seized with artery forceps and the ganglion avulsed. This operation is difficult and attended with considerable risk, but when successfully performed it is usually curative of the neuralgia.

NEURALGIA OF SCARS AND STUMPS.

A sensitive nerve may be caught in the healing of a wound and subsequently the cicatrix becomes painful. If no known nerve is implicated, the scar should be excised.

Occasionally after an amputation in which the nerves are cut long, the stump becomes very painful. This condition occurs more especially in stumps which suppurate and is due to the irritation and pinching which the nerve receives in the healing process and in the cicatrix, especially when the nerve is much irritated, it forms upon its extremity. A bulb is made up of new connective tissue and enclosing many sensitive nerve fibers. The bulb may become enclosed in the cicatrix and be greatly irritated by the contraction of the same, the pressure of an artificial limb, or in consequence of muscular contraction. In these cases there is likely to be as many sensitive bulbs as there are prominent nerves. The bulbs often reach the size of the end of the little finger. They are usually quite sensitive and can be readily felt beneath the skin as firm, oblong, elastic tumors.

TREATMENT.—This consists in exposing the bulb or bulbs by an incision along the course of the nerve, dragging the nerve out, and resecting the bulb and something of the healthy nerve.

INJURIES TO NERVES--CONTUSIONS, LACERATIONS AND WOUNDS.

In consequence of the exposed position of the peripheral nerves they are subject to various traumatisms.

The symptoms of a contusion or laceration affecting a sensitive nerve are pain, which is usually severe; shock, which may be pronounced; sensitiveness over the injured nerve; numbness, or a sensation as of pins and needles; or a loss of sensation and possibly paralysis throughout the area of distribution of the nerve implicated. Loss of sensation is often less affected than is loss of motion, and frequently is sooner recovered from. In determining the nerve injured the surgeon must note the muscles paralyzed and the area deprived of sensation. This, with the known nerve supply, will readily show the nerve injured. If a nerve is irritated or contused, but not divided, there is likely to be pain throughout the area of its distribution, with altered sensation, and often painful muscular twitchings.

TREATMENT.—The part should be put at rest and the pain relieved, if necessary, by morphine. If there is much inflammatory exudate, a compress and snugly-fitting bandage may be necessary. After the acute symptoms have subsided, and in the absence of paralysis, galvanism and massage are serviceable. In case an important nerve has been divided, resulting in paralysis and loss of sensation to important structures, the nerve should be immediately exposed under proper antiseptic precautions and its ends reunited by suture. The process of reuniting a nerve after division has been divided into immediate and remote, or primary and secondary suture.

If the nerve is properly sutured function is likely to be re-established i from ten to fourteen days, without marked degeneration either in th nerve or the tissues which it supplies. In some cases the nerve seem almost immediately capable of transmitting nerve influences, and function i restored inside of twenty-four hours.

Technic of Nerve Suture.—An incision sufficiently long should b made over the course of the nerve, so as to thoroughly expose the two ends In the case of the long nerves the ends are likely to be separated for fron one to three inches, in consequence of contraction and retraction of tissue The ends of the nerves are picked up with forceps and sutured with silk In suturing a nerve a small round needle should be used, carrying a mediun sized silk thread. Two sutures are passed directly through the nerve, on perpendicular the other transverse. Additional sutures may be taken through the epineurium if thought best. The sutures are tied loosely, s that the ends of the nerve simply touch each other. Even if there is a slight interval, no harm is done. If the sutures are tied tightly the nerv fibers at the cut ends are bent, turned to the side, union hindered, and restoration of function delayed or prevented. If primary nerve suture i done properly and aseptically restoration of function can be secured i almost every case.

Secondary Nerve Suture.—By this is meant the suture of a divided nerve after an interval which may be represented by days or even months Following section of a peripheral nerve there is a separation of the end of from two to three inches, and there is formed about each end a bulb which consists of fibrous tissue and nerve fibers. The proximal bulb i larger than the distal, and their size depends very much upon the presence or absence of irritation, such as infection, pressure of contracting muscles or the irritation of a cicatrix. Following section, the axis-cylinders and medullary sheaths break up into fat drops and disappear. The nerve then consists of but little more than a fibrous cord. Sensation and motion are lost throughout the area supplied by the divided nerve, and the tissues undergo atrophy. In some cases following division of a nerve without suture sensation and motion are partially or completely restored. This does not mean necessarily that the two ends of the nerve have reunited, but rather that the functions of the divided nerve have been taken up by adjacent or anastomosing nerves. Not infrequently a muscle or group of muscles have a double nerve supply. This is well illustrated in the case of the trapezius, where the spinal accessory is occasionally divided in the removal of the cervical glands, with subsequent shoulder drop and marked deformity. Function usually returns to these muscles, in consequence of their nerve supply from the anterior branches of the third and fourth cervical and an anastomosing branch from the second. As a rule, however, it may be stated that after section of a peripheral nerve and without suture loss of function is complete and permanent.

Clinically and experimentally it has been repeatedly demonstrated that function can be restored in a considerable number of cases by secondary suture. The longer the time which has elapsed between section of the nerve and suture the less likelihood there is of success. If the interval is only a few weeks, or two or three months, o[illegible] likely to succeed. If the

interval is more than six months one will fail in the great majority of cases.

Technic of the Operation.—If the nerve is a superficial one the bulbous ends can usually be felt as round or oblong, hard, and quite sensitive enlargements which readily roll under the finger during the examination.

An incision is made in the long axis of the nerve, the bulbs exposed, separated and freely removed by dividing the nerves directly behind the

Fig. 168.—Secondary suture of a nerve. Bridging the defect with silk.

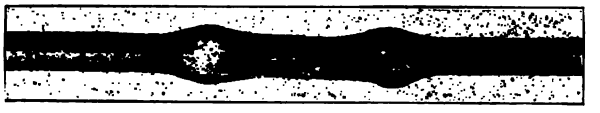


Fig. 169.—Showing a bridge of muscle in the sciatic nerve of a dog. 21st day.

Fig. 170.—Transverse section through regenerated nerve in a bridge of muscle. Specimen taken on 21st day.

bulbs. There will usually then be an interval of two, three or four inches between the cut ends, which should be bridged over with several strands of silk (Fig. 168).

The nerve should not be stretched and no effort made, if the interval exceeds one inch, to bring the ends together. The formation of a connecting link in the way of a bridge or scaffolding is sufficient in recent cases to re-establish the nerve impulses through the peripheral end

of the nerve, and stimulates both ends of the nerve to take on reparative process. The scaffolding and gap between the ends of the separated nerve are filled by inflammatory exudate, which becomes organized and through the neurilemma sheaths and nuclei from each end of the nerve send prolongations. It is now pretty well established, as I advocated in 1898 in an article on *Injuries to Peripheral Nerves and Their Surgical Treatment*, read before the American Medical Association, that the axis-cylinders in the case of nerve suture are produced by the neurilemma and its nuclei. These delicate threads or offshoots from the neurilemma nuclei are everywhere to be seen on section and form the subsequent axis-cylinders, and unite in the center of the bridge until finally the repair is sufficient so that the function of the nerve is restored.

Instead of making a bridge of strands of silk, a portion of the peripheral nerve may be resected from an animal and inserted into the gap; or, if the wound is favorably situated, a portion of the adjacent muscle with its fascia may be inserted into the gap (Fig. 169). If the nerve is quite large it may be partially divided at a suitable distance from each extremity, split and these pieces turned down as flaps to bridge the defect (Fig. 170).

SKIN-GRAFTING.

Skin-grafting is employed to hasten the healing of large ulcerating surfaces, and to cover fresh wounds in which the borders of the skin cannot be approximated. Before grafting an ulcer, the surrounding skin and surface of the ulcer should be rendered aseptic, and the surface of the granulations removed by a sharp curette, knife or shears. The hemorrhage is to be arrested following the curettement by the application of compresses wrung out of hot water. The skin from which the grafts are to be taken is also to be asepticized.

Reverdin's Method.—Small pieces of the epidermis are cut with scissors and placed upon the ulcer at different points, to act as islands for the epidermization of the surrounding areas.

Thiersch's Method.—This procedure is pretty generally resorted to at the present time in suitable cases.

Technic.—The ulcer and skin surface are prepared as before. The most suitable areas from which to remove the grafts are the anterior and lateral surfaces of the thighs. In cutting the grafts the surface from which the grafts are to be taken is put upon the stretch by upward and downward traction, and the surface moistened with normal salt solution. The razor is also moistened with the same solution, and the flat surface applied to the skin, when with a firm sawing motion forwards and backwards a thin graft of the epidermis is cut. The graft may be an inch or more in width and two or three inches in length. It should be confined as near as possible to the epidermis, the procedure only bringing a show of blood to the part. The grafts are carried by the razor upon which they lie to the ulcer and then with needles gently slid off into the wound, where they are carefully spread out upon its surface. A sufficient number of grafts are cut so as to cover the entire extent of the wound. Strips of sterilized oil silk, muslin or rubber protective tissue, one inch wide are then cut, and ster-

ilized olive oil smeared over one surface. This surface is to be applied to the wound. The entire area should be covered with the strips. Over the protective strips is placed a compress of sterilized gauze wrung out of a hot salt solution, and over this a dry dressing and bandage. The wound upon the thigh receives the same treatment. The dressings are changed on the fourth or fifth day, and the same kind of dressing re-applied. At the end of a week the grafts will have gained sufficient hold upon the tissues so that a small, gentle stream of normal salt solution may be allowed to run over the wound. The results are most satisfactory, in that the wound heals much more readily, while contraction of tissue and deformity are prevented.

CHAPTER XII.

TUMORS.

A tumor may be defined as an independent, more or less circumscribed new-growth. Tumors have certain well-defined characteristics.

First, they have no useful function.

Second, as a rule their growth is continued throughout the life of the individual, being uninfluenced by health, disease or medication.

Third, their growth is in most cases prejudicial to the life of the individual.

Fourth, they often produce injurious compression upon adjacent organs.

Fifth, they are often the cause of secondary tumors in different parts of the body.

Sixth, they never originate *de novo*, but always from pre-existing tissue.

Seventh, the tissues of which they are composed are prone to undergo degenerative changes, such as fatty, colloid, hyaline, calcareous and amyloid.

Eighth, tumors correspond in their histological structure more or less closely with the tissues in which they grow, epithelial tumors springing from epithelial tissues, fibroid tumors from fibroid tissues, muscle from muscle, etc.

General Etiology of Tumors.—Comparatively little is known in regard to the causation of tumors.

The Embryonal Cell Theory.—Remak was the first to advance the idea that a growth of embryonal cells might wander to a distant part of the body and subsequently be the starting point of a tumor. Cohnheim endeavored to show that all tumors were formed by this method. This theory is most ingenious and has been given quite general support. In a few words the theory is that in embryonal development more cells are formed than are found necessary for the various tissues and organs of the body, and that a number remain unused and dormant. These superfluous cells at some subsequent time in the history of the individual may receive such a stimulus as to cause them to proliferate rapidly, with the result that a tumor is formed. Cohnheim's theory undoubtedly holds good with the formation of many tumors. The hypernephroma of the kidney is due to the inclusion of a portion of the adrenal body. Tumors of the jaws, ovary and testicle are frequently the result of an over-growth of these embryonal cells. Vestiges of the urachus, thyro-glossal duct, post-anal gut, and Pflüger's tubes may be the site of tumor formations.

For the purpose of considering the causation of tumors, they may be divided into six groups, according to their tissue origin or mode of development:

(1) Connective tissue tumors.
(2) Epithelial tumors.
(3) Cysts.
(4) Dermoids.
(5) Teratomata.
(6) Malignant growths.

The cause of the third, fourth and fifth groups is well understood and distinctive, in that they do not depend to any extent upon cellular proliferation for their origin and growth.

Cysts may be divided into four principal species:

(1) The retention cyst.
(2) Those produced in epithelial rests and vestiges.
(3) The inflammatory cyst.
(4) The cyst of parasitic origin.

The retention cyst is caused by the mechanical obstruction of one or more of the acini of a gland or by the obstruction of the duct. In consequence of this obstruction the gland's secretion is retained and dilates the gland, or some portion of it, into a cyst. Examples of this form of cyst are the sebaceous and mucous.

The second class of cysts are those produced in epithelial rests or inclusions of embryonal tissue. The parovarian and paroöphoron cysts and the cysts of the maxillary bones are examples. In fetal life there is an intimate relation between the ovaries, or testicles, kidneys and Wolffian bodies. The latter are composed of transverse tubules lined by a low columnar or ciliated epithelium. With the development of the kidneys, ovaries or testicles these epithelial cords should disintegrate and disappear, but at times they do not, and as a result of some irritation the cells proliferate, a cyst-wall is formed, a serous fluid fills the sac, and, dependent upon the position, we have a parovarian or paröphoron tumor. Solid epithelial tumors may also be formed from the same rests.

Cysts are also inflammatory or traumatic in origin. An inflammatory or traumatic exudate occurring, a portion of the fibrin may be absorbed, while the remainder becomes organized and the adjacent cells take on a rapid proliferation, with the result that a fibrous capsule lined with endothelial cells and containing serous fluid is formed.

Dentigerous cysts of the jaw occur as the result of the irritation of a non-erupted tooth.

A cyst may be of parasitic origin. The cysticercus and tænia echinococcus are examples.

Formation of Dermoids.—The method of the formation of dermoids is theoretically so well understood that we need but refer to it. Here we have inclusions of epithelial cells, portions of the epiblast or hypoblast; that is, inclusions of the skin or portions of the mucous membrane within the deeper structures of the mesoblast. In consequence of this infolding, the glandular products of that portion of the skin or mucous membrane impli-

cated are retained within the tissues and press aside the adjacent structu with the result that a dermoid cyst is formed.

The *teratomata* are congenital in origin, and may be solid, cystic, la or small, benign or malignant. Bland Sutton holds that they are the re of the suppression of a fetus attached to an otherwise normal individ It is probably true that many of the teratomata are due to inclusions of p tions of two or all of the germ layers. These tumors frequently take ori from the ovary and from the sacral region.

Causation of Connective Tissue Tumors.—It would seem that m of these tumors are due either directly or indirectly to the increased bl supply incident to irritation or infection. The myxomata of the na pharynx are usually secondary to chronic nasal catarrh. The so-called c moid of the abdominal wall is practically always secondary to an inj or follows the stretching of the abdominal walls incident to pregnancy. keloids occur in irritated cicatrices, and especially in those that have forr during the process of infection. The osteomata, occurring in tendons muscles, are usually due to chronic inflammation or irritation. Ocul attribute the bone plates which are often found in the uveal tract to inj followed by chronic inflammation. In the long bones the greatest num of tumors occur at the epiphyseal line, and follow some injury or str Excessive growth of bone has occurred about the face or different parts the body, as the result of irritation or chronic inflammation. Virchow h that the osteomata in the lungs were usually due to chronic inflammati The papillomata usually occur upon the skin, mucous membranes, wit glands and ducts, and are often the direct result of irritation. This is illustrated upon the hands of those who have delicate skin and who at same time are not careful to keep their hands clean and dry. Such ir viduals are very likely to suffer from warts.

Fatty tumors occur with special frequency in parts subjected to jury and irritation, or at the site of some chronic inflammation. Those occur upon the back and shoulders are thought to be due frequently to irritation of the suspenders. Lipomata are frequently found at the knee shoulder joints, presumably as the result of injuries. The very frequ occurrence of lipomata around hernial sacs and in hernial canals is o due to the irritation of a truss. A patient of mine was struck between shoulders by a base ball. There was considerable induration following injury, in which a fatty tumor appeared.

Multiple and symmetrical lipomata are often connected with the s sitive nerve filaments and it is thought by some pathologists that irrita of these nerves is a causal factor.

The *myomata* are at times seemingly the result of hereditary influen for one often finds them occurring through two or three generati Uterine myomata are frequent in unmarried and sterile women, and es cially in those who have menstrual disturbances. Chronic inflamma and perversion of the sexual functions are seemingly causative factors.

The Effects of Traumatism, Continued Irritation or Inflammation u the Tissues.—A traumatism may lead primarily to the formation of a ha atoma from the rupture of blood vessels. A hæmatoma instead of be completely or partially absorbed may become organized and afford a s

folding for the growth of adjacent granulation tissue which proliferates vigorously. In this way a solid tumor may be formed. This tumor, depending upon the tissues injured, may be a fibroma, a lipoma, an osteoma, a sarcoma, or an epithelioma. A severe traumatism, or long continued irritation, will be followed by the process of repair, which is ordinarily known as an inflammation. This in the main is a purposeful process, but following the injury the element of repair may be over-excited and new tissue in excess formed, causing tumor.

Malignant Growths.—Every one is familiar with the effects of injury, constant irritation and chronic inflammation in the production of these tumors; the hot stem of a clay-pipe in the production of epitheliomata of the lip and tongue; the prodding of a sharp tooth in carcinoma linguæ; the scrotal cancer in chimney-sweeps and paraffin workers; carcinoma of the stomach following dram-drinking; the irritation of gall stones causing carcinoma of the gall bladder, and the epitheliomata and carcinomata of the cervix following lacerations or repeated abortions. Indeed the frequency of carcinomata, sarcomata and endotheliomata following injuries are matters of every day observation.

non-carcinomatous cases tubercular lesions occurred in only about thirty p cent.

Of course there is something radically different between a benign a malignant growth, and while injury, continued irritation or chronic flammation may be sufficient to so change the growth of the normal c as to lead to the production of a benign tumor, it must be evident that th conditions cannot be more than predisposing factors in the production malignancy. Malignant tumors, with their rapid growth, widespread met tases, their excessive virulence and destruction of tissue must possess son thing which is unique and typical, and it would seem at least from clini experience that this factor was intracellular, for in the granulomata all t is necessary for the production of new tissue is that the germs of a parti lar disease be implanted within the tissues under favorable conditions, wh in the malignant growths the cells of the neoplasm must be carried to d ferent regions in order that metastasis occur.

ETIOLOGICAL SUMMARY.—

1. Tumors never occur in perfectly healthy and normal tissues or dividuals.

2. Teratomata are usually congenital growths, and are due to clusions of one or more of the germ layers.

3. The cysts are due to a variety of causes, such as the obstruction a duct or an acinus of a gland; stimulation of epithelial rests or vestig traumatisms; inflammations; and parasites.

4. Solid epithelial tumors also occur in epithelial rests, as the res of stimulation or irritation.

5. Solid connective tissue tumors are often the direct result of an jury, continued irritation, chronic inflammation, perverted function, a probably of heredity.

6. Papillomata are usually produced by local irritation.

7. The granulomata are due to the irritation incident to the prese of germs within the tissues. These growths are always made up of c nective or granulation tissue.

8. The malignant growths. While injury and irritation are seem factors in the production of these tumors, it is evident that there is son thing more potent than this, which is special, specific and forceful. Wh ever this energy, or perhaps organism, is, it must lie within the cells, a be capable of exerting its remarkable influence both upon the epithelial a connective tissues. And this influence differs markedly from that of organisms of the granulomata. It is possible that this misplaced ene acts in two ways; in the one it changes the relationship and removes restraining influence of the adjacent cells, and in the other it incites cells implicated to proliferate remarkably. This, in substance, is the the of Ribbert.

CLINICAL CHARACTERISTICS OF BENIGN AND MALIGNANT TUMORS With few exceptions the growth of benign tumors will be slow, uniform, interrupted, and often scarcely appreciable from month to month, or of from year to year. This slow growth may be an inherent characteristic of tumor, or the result of a poor blood supply. Occasionally a benign tum such as a soft fibroid or a cystoma, takes on rapid growth.

Benign growths are possessed of a distinct capsule, which they do not transgress, the tumor cells never passing beyond the capsule into the surrounding tissue. Benign neoplasms are freely movable and are easily shelled out of their bed. The border of a benign tumor is easily defined and readily marked off from the healthy tissue. Benign tumors have a pretty uniform density which, as a rule, either equals or exceeds that of the surrounding tissue. They frequently undergo formative changes, parts of the tumor being converted into tissue of a higher grade—a myxoma into a chondroma, or osteoma, and fatty tumor into a fibroid,—while occasionally they undergo degenerative changes, the tissue of the tumor being converted into that of a lower grade.

Metastases never occur in the growth of benign tumors, nor do they implicate the lymphatic glands.

Benign tumors, if completely removed, never return. Their growth is usually painless, because they do not infiltrate or destroy adjacent tissue, simply push it to one side.

Benign tumors in their growth do not form ptomains or toxines, or readily undergo suppurative or ulcerative processes; consequently they do not affect the health, constitution or well-being of the patient, except mechanically, nor do they produce cachexia.

Characteristics of Malignant Tumors.—As compared with benign growths the malignant have a much more rapid and irregular growth, attaining perhaps in a few months a size which it would require a benign tumor as many years to reach. Their growth is not uniform nor always progressive but, on the contrary, very variable, now fast and then again slow, or often seemingly to diminish in size. Malignant growths are often of unequal consistence, at points hard or of seeming hardness, and then soft and even fluctuant. If cysts are present they will be irregular, of varying size, thin-walled, and often made to project above the surface of the growth. The cysts are usually filled with blood and debris, the result of hemorrhage and the breaking down of the softer portions of the tumor.

Malignant tumors are made up very largely of cells. The cells are poorly supplied with blood, and consequently in a low state of nutrition. The blood vessels are often thin-walled, or possessed of but an endothelial coat, or are without coats other than the cells of the part. Malignant growths never have a capsule which is not transgressed by the tumor cells. The great majority are without even the semblance of a capsule, and as a result of their growth they infiltrate, perhaps destroy, the adjacent tissue. As a result of their non-encapsulation they seldom have a definite border, but shade off almost imperceptibly into the healthy tissue.

Pain is usually caused as the result of the growth of malignant tumors. This may be burning, gnawing, piercing or lancinating, which is often severe, and sometimes excruciating. Pain is caused by the infiltration and destruction of normal tissue, with the pressure upon and irritation of sensitive nerves.

One of the chief characteristics of malignant growths is that they produce metastatic deposits in various portions of the body and implicate the adjacent lymphatic glands.

In some persons suffering from cancer there appears during the co of the disease a condition which has been termed the cancerous cache This is described as characterized by loss of health and strength, by anæ sallowness of the skin, and a care-worn, haggard expression of the cc tenance. The so-called cancerous cachexia seldom occurs until late in disease, when ulceration, suppuration and general systemic infection taken place. General systemic infection is probably an indispensable dition, while ulceration and suppuration are adjuncts. Of the cases cancer which come under observation probably not one person in tw will show the symptoms of cachexia.

CLASSIFICATION OF TUMORS.—Tumors have for many hundreds of y been divided into the benign and the malignant. The benign tun may be subdivided into the connective tissue tumors; tumors made u large part of the blood vessels; the cysts, and the epithelial tumors.

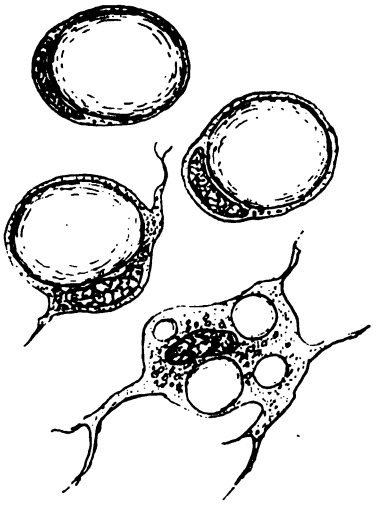


Fig. 171.—a.—Connective tissue cell in which there are fat drops. b.—Connective sue cell filled with fat.

The connective tissue tumors may be divided into (1) lipomata, fibromata, (3) osteomata, (4) chondromata, (5) odontomata, (6) m mata, (7) gliomata, (8) angiomata, (9) myomata, (10) sarcomata.

LIPOMATA OR FATTY TUMORS.

A lipoma is composed of tissue identical with normal fat, and sequently in histological structure is made up of round cells each havir membrane, a nucleus, and a small amount of protoplasm. The cells primarily connective tissue cells which have become filled with fat. If quantity of fat is small it may be distributed through the cell as larg small drops; when the quantity is large the separate drops run toge making a large fluid mass which fills and distends the cell, thus for the nucleus and protoplasm against the cell wall (Fig. 171). Fat cells highly refractive and under a microscope glisten strongly. They lie dire

one upon the other, being collected into bunches or lobes, which are surrounded by connective tissue. The surface of a lipoma is nearly always uneven and nodular, owing to the formation of lobules. A lipoma is surrounded by a thin, connective tissue capsule which sends partitions through the tumor supporting it. The amount of this connective tissue varies greatly; at times it is very considerable, making a firm and hard growth--lipoma fibrosum—again the amount of connective tissue may be small, the tumor being composed largely of fat—lipoma molle. The capsule of the tumor is formed by the condensation of the connective tissue in the immediate vicinity of the tumor (Fig. 172).

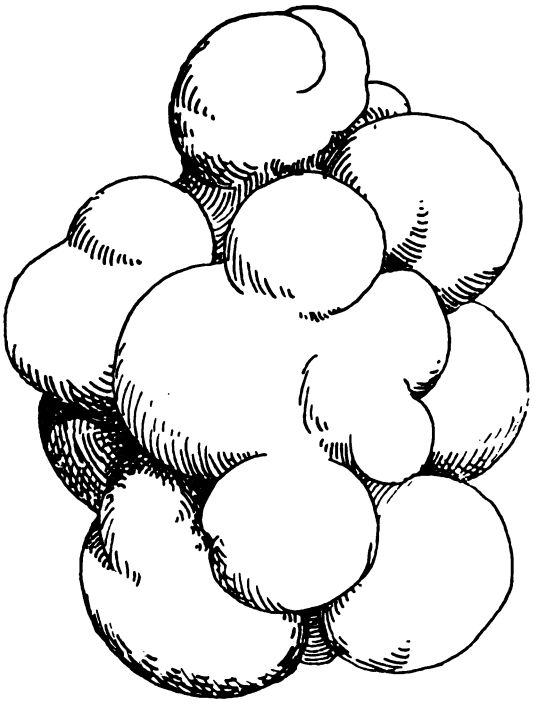


Fig. 172.—Fatty tumor showing the lobules.

Fatty tumors follow very closely in their situation the normal fat layers, such as the subcutaneous, subserous and submucous tissues. While fatty tumors are most frequently found in one or the other of these layers, they may occur not only where fat is physiologically present but also in tissues where fat never is found except as the result of a pathological process (Fig. 173).

Diagnosis.—The diagnosis of fatty tumors which are situated subcutaneously is ordinarily easy. A lipoma is a typical benign tumor, and consequently never causes metastasis. It is of slow growth, painless, irregular or nodular in form, usually completely encapsulated, and consequently freely movable, soft, and often semi-fluctuant. The subcutaneous portion of a fatty tumor is connected with the skin by numerous strands of connective tissue;

consequently when the tumor is moved in different directions these strands drag upon the skin, producing dimples. Occasionally a fatty tumor has a perfectly smooth surface and does not produce dimpling of the skin when moved.

TREATMENT.—Lipomata being benign tumors their removal is not always a necessity. They may be removed for cosmetic effect, and should be removed if on account of their location they are likely to be inconvenient, or to subsequently cause injurious pressure upon adjacent organs.

Fig. 173.—Fatty tumor of the shoulder. Twelve years' growth.

In the operative technic of a subcutaneous and strongly projecting lipoma two curvilinear incisions should be made, excising a considerable portion of the overlying skin so that the cut surfaces after the removal of the tumor will fall evenly together and without folds. After incising the skin and superficial fascia the tumor can ordinarily be shelled out with the fingers, aided by a few strokes of the knife. If the strands of connective tissue binding the tumor to the skin are numerous and strong, the knife must be used more vigorously. After the removal of the subcutaneous

lipoma a very considerable cavity is left, which should be obliterated, if possible, by bringing the cut surfaces accurately together, so as to avoid any dead spaces; otherwise the wound should be drained.

FIBROID TUMORS—FIBROMATA.

A fibroid tumor is composed of fibrous or connective tissue, with more or less of elastic tissue, blood vessels, nerves, and lymphatics. Wherever connective tissue is present in the tissues or organs of the body there a fibroma may occur. A fibroid may be very soft, being composed of a loose meshwork of interlacing fibers rich in stellate and spindle cells and containing a considerable quantity of fluid—fibroma mollé; or very hard and composed of dense wavy masses of white fibrous tissue in which there is no fluid and but few cells—fibroma durum. The soft fibroids grow more rapidly than the hard, on account of their increased blood supply and by reason of the fluid which they contain (Fig. 174).

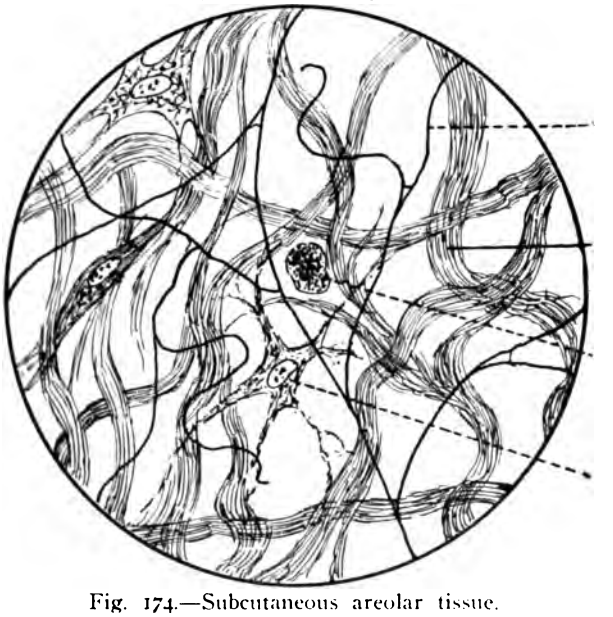


Fig. 174.—Subcutaneous areolar tissue.

Fibroid tumors are frequently mixed, in that they contain some other tissue than fibrous tissue. They frequently contain fat, and then are known as fibro lipomata; or bony tissue, and this is especially true when they take origin from the periosteum, and are then known as fibro-osteomata. The so called uterine fibroids are nearly always composed more or less of muscular tissue, and are then known as fibro-myomata. Occasionally when a fibroid occurs in gland structure it will take on the characteristics of an adenoma, or fibro-adenoma. Again, not infrequently, and very unfortunately, fibroid tumors take on malignant change in that they become in part sarcomatous, and are then known as fibro-sarcomata (Fig. 175).

Fibroids grow with especial frequency from periosteum, fascia, bone, mammary glands, uterus, ovary, nerves, and occasionally are found taking

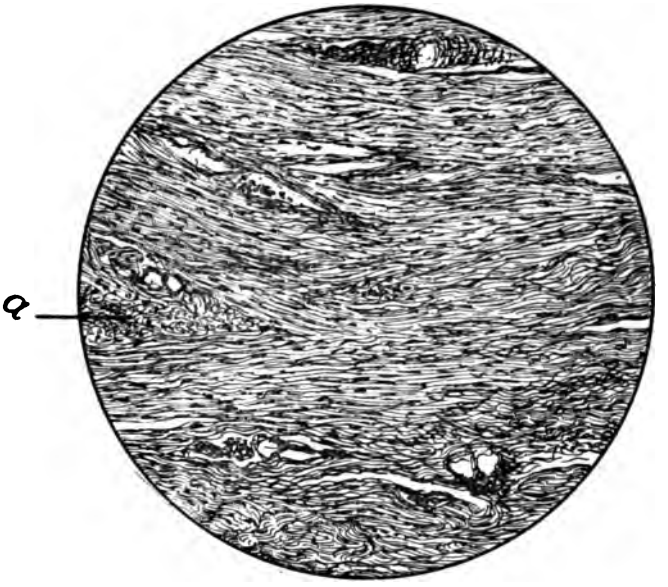


Fig. 175.—Dense Fibroma of abdominal wall. Fibroma durum. a.—Connective tis fibres cut across.

origin from the skin, and the mucous, serous, and synovial membrar They are frequent in the nasal cavities and in the naso-pharynx.

DIAGNOSIS.—Fibroids as a rule occur in adult life. They are ha often nodular, usually irregular, distinctly encapsulated, and consequer freely movable growths which do not produce metastases, and do not afl the health or well-being of the patient.

Fig. 176.—Osteomata of the cranium.

TREATMENT.—Fibroid tumors on account of their hardness and liability to produce pain, and to undergo sarcomatous change, should be removed under ordinary conditions.

OSTEOMATA, OR BONY TUMORS.

These tumors, when compared with other connective tissue tumors, are of infrequent occurrence. They may be single, but are quite often multiple and occasionally occur in large numbers as symmetrical or congenital growths. The osteomata have been variously classified according to their structure. Virchow divided them into three classes. In the first were ivory-like growths or osteomata dura (Fig. 176). These are most frequently situated upon the vault of the cranium within the external auditory meatus, or upon the walls of the frontal sinus, or antrum of Highmore.

Fig. 177.—Hyaline cartilage.

They are characterized by their extreme density, slow growth and small size.

The second class of osteomata are made up of tissue corresponding to that of spongy bone—the osteoma spongiosum.

The third class or subdivision are those composed of a thin shell of compact bone upon the exterior, while within there is cancellated bone and in the interior a medullary cavity filled with marrow—medullary osteomata.

DIAGNOSIS.—The osteomata are small, hard, painless, very slow-growing tumors which occur as a rule during middle life. If having their origin from bone, cartilage or periosteum; they are usually fixed and immovable; if occurring within soft tissues, they are quite movable. They are distinctly benign growths.

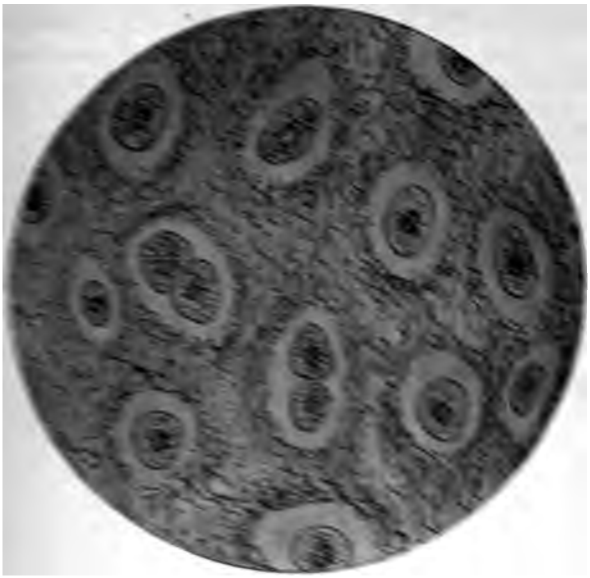


Fig. 178.—Elastic cartilage.

[illegible].—If they are producing [illegible] pressure [illegible] they should be removed [illegible] they are [illegible] incision, the [illegible] and the tumor [illegible].

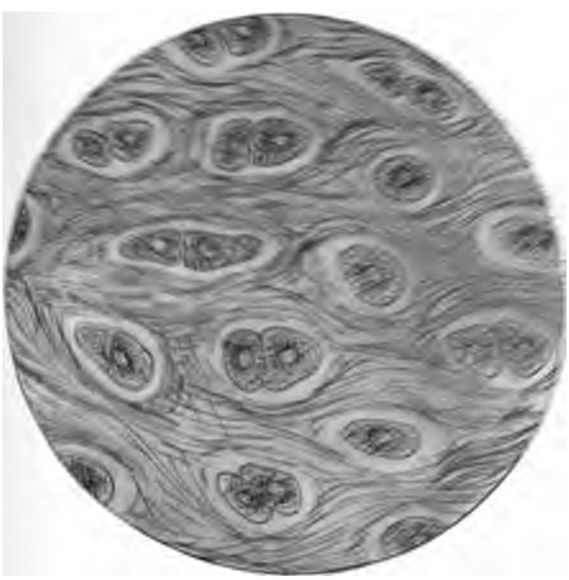


Fig. 179.—Fibro-cartilage.

CHONDROMATA. OR CARTILAGINOUS TUMORS.

Cartilage, as is well known, has been divided into three classes, first, the hyaline cartilage; second, elastic cartilage, and third, fibro-cartilage. These different names are expressive of the condition of the intercellular substance. In hyaline cartilage it is practically amorphous; in elastic cartilage the intercellular substance is made up largely of elastic tissue, while in fibro-cartilage the intercellular substance consists largely of fibrous tissue (Figs. 177, 178, 179). Any one of these forms of cartilage may enter into the formation of a cartilaginous tumor.

Cartilaginous tumors may occur as outgrowths from bone, epiphyseal or articular cartilages and from cartilages situated elsewhere in the body,

Fig. 180.—Chondromata of the ear.

or they may take origin from or within the periosteum, synovial fringes, muscle, tendon, fascia, or gland.

Diagnosis.—It may often be difficult to differentiate a chondroma from an osteoma. The chondromata are very slowly growing, quite hard, elastic, usually fixed, tumors, which make their appearance in adult life, and usually have their origin from some cartilaginous structure (Fig. 180).

Treatment.—If a chondroma is unsightly or producing severe pressure symptoms, or is likely to be an annoyance to the patient, it should be removed.

ODONTOMATA. OR TUMORS OF THE TEETH.

The teeth are composed of four principal parts which may be classified as follows: From within outwards is first the pulp, which supplies through its blood vessels and nerves nutrition and inervation; second, situated out-

side of this and as a result of the action of the pulp cells is the dentin, which encloses the pulp and makes up the principal part of the tooth, giving it form and shape; third, outside of the dentin, and in a measure giving protection to this structure upon the crown, is the enamel; fourth, surrounding the root and covering the dentin is the cementum. That portion of the tooth within the alveolus is called the fang. The exposed part is known as the crown (Fig. 181).

The teeth take their origin from two kinds of tissue. One of these is the epithelium of the mucous membrane of the mouth, and the other the

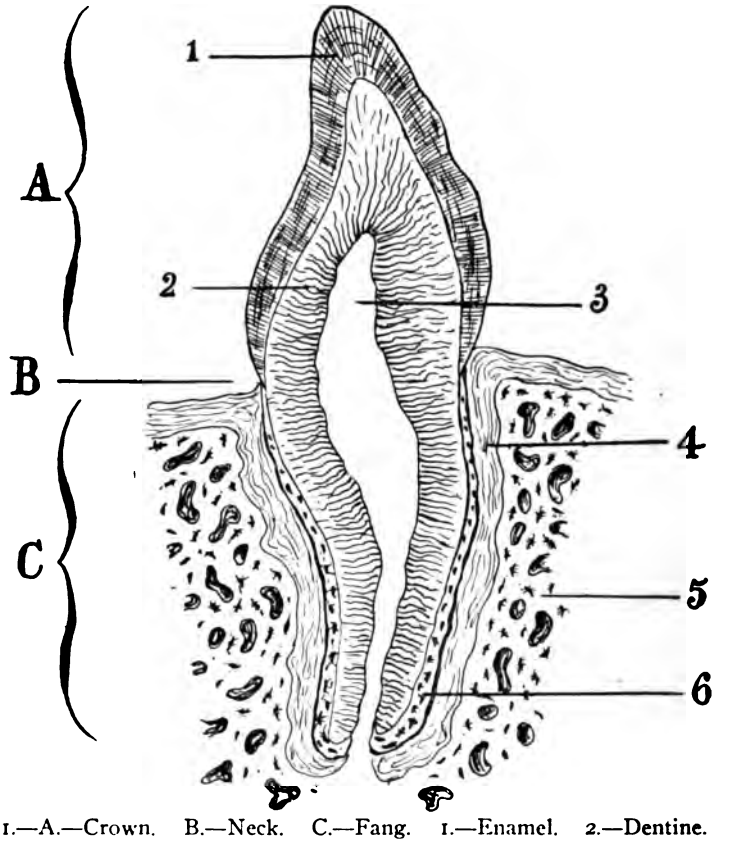
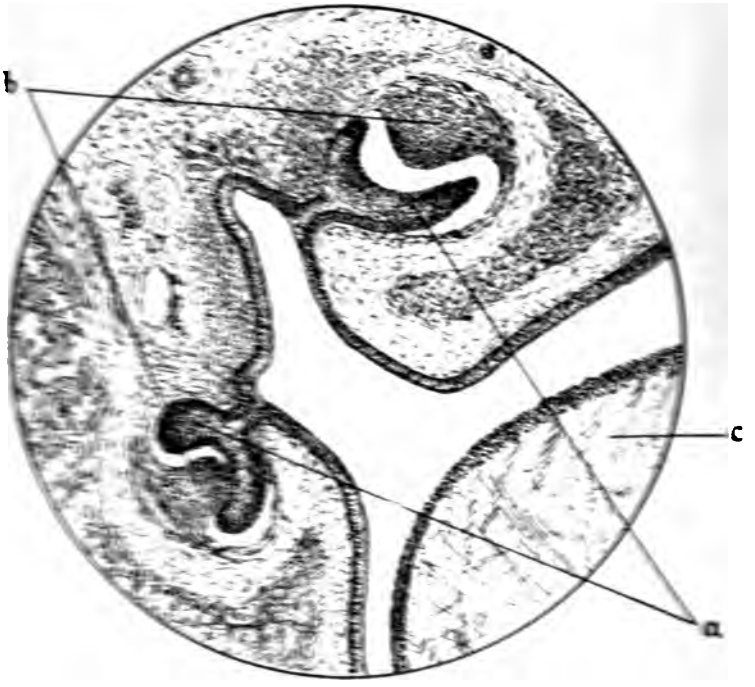


Fig. 181.—A.—Crown. B.—Neck. C.—Fang. 1.—Enamel. 2.—Dentine. 3.—Pulp cavity. 4.—Dental periosteum. 5.—Bone of jaw. 6.—Cementum.

connective tissue of the jaw. Consequently they are epiblastic and mesoblastic in origin. This fact must not be lost sight of in the consideration of the tumors of the teeth. At about the sixth or eighth week of fetal life, as a first process in the formation of the teeth, a slight linear thickening of the mucous membrane occurs in the form of a half circle immediately over the jaws and at the site of the future tooth. The growth of epithelial cells is from the under surface of the epithelial layer of the mouth, and dips down into the connective tissue, forming what is called the dental ridge. At about the tenth week the dental ridge develops upon its lower surface

epithelial outgrowths or bulbs which become invaginated or cup-shaped (Fig. 182). At about this time the dental papillæ are produced directly beneath these cup-shaped bulbs by a process of hyperplasia. This before mentioned cup-shaped mass of epithelial cells is the future enamel organ and as it envelops the papilla is composed of three distinct layers or cells, an outer columnar layer in direct communication with the dental ridge and mucous membrane of the mouth, and an inner layer of columnar cells, which is the invaginated portion and the direct continuation of the outer layer (Fig. 183). Between these two layers is the more or less thick zone of stellate epithelial cells making up the enamel pulp. Later this enamel pulp becomes pressed together into a very thin, hard plate. The enamel



[illegible] —Dental papilla [illegible]

[illegible] concerned in the produc- [illegible] membrane. Coincident [illegible] the superficial cells of [illegible] selves in a continuous [illegible] The cementum [illegible] tooth by the ossifica- [illegible]

[illegible] have, however, been

3. Simple cystic odontomata
4. Dentigerous cysts
5. Fibrous odontomata — From the tooth follicle.
6. Cementome
7. Radicular odontomata — From the papilla.
8. Composite odontomata — From the whole organ.

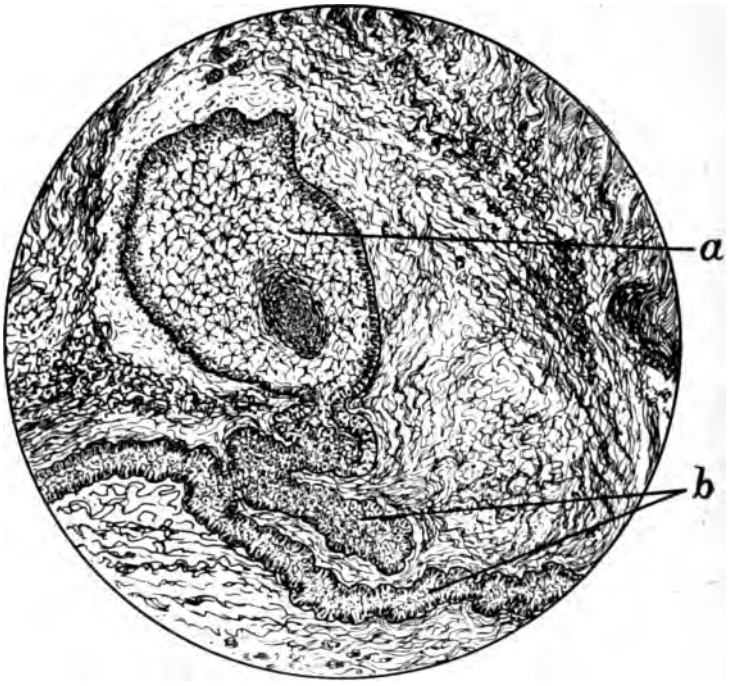


Fig. 183.—Showing enamel organ of permanent tooth. a.—Enamel organ of perr nent tooth. b.—Cords of epithelial cells from mucous membrane.

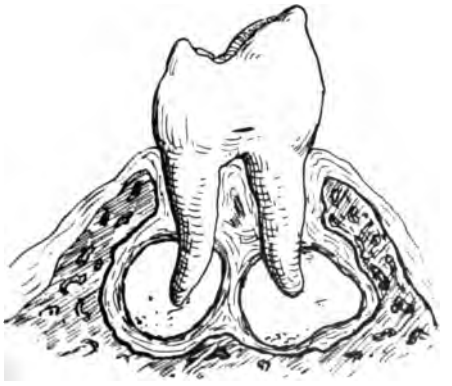


Fig. 184.

Fig. 185.—Dentigerous cyst formed around non-erupted teeth.

Epithelial Odontomata.—Very few of these tumors have been described. They take origin from the enamel organ, have usually been congenital, the size of a pea or bean, and have been benign in character. The treatment is excision.

Cystic Odontomata.—The cystic odontoma has its origin from the rests of epithelial cells laid down in submucous tissue during the formation of the deciduous or permanent tooth. These pegs of cells should undergo degeneration and absorption, but occasionally they remain and are the site of cystic tumors. These tumors are rare, small in size, and benign in character, and should be removed when creating any considerable disturbance.

Simple Cystic Tumors.—These cysts are rare, but do occur in direct relation with the root of a devitalized tooth (Fig. 184). They are usually small, often not larger than a pea or hazelnut. The history usually shows that there has been more or less disturbance of the tooth, associated with pain, and followed by decay. The tooth may be in position, or it may have been extracted. In consequence the tumor seldom reaching any consider-

Fig. 186.—A dentigerous cyst formed around a non-erupted tooth.

Fig. 187.—Fibrous odontome.

able size, the jaw is not markedly expanded. If there is any considerable deformity, an incision should be made down to the bone, the alveolar process broken through, and the cavity curetted out and drained.

Dentigerous Cysts.—These are the only cysts connected with the teeth which have received any considerable attention from surgical writers. They are usually developed in consequence of the irritation, and in direct connection with a non-erupted tooth of the permanent set. The tooth may lie quite loose at the bottom of the sac, or be surrounded by granulation tissue and fixed. The tumors may reach almost any size and cause great expansion of the bone, and such thinning that it often crepitates like parchment (Figs. 185 and 186).

The diagnosis is ordinarily easy, in consequence of the tumor being at the seat of a non-erupted tooth.

The treatment consists in making an incision down to and into the sac, removing the tooth and curetting the cavity.

Fibrous Odontomata.—In the case of a non-eruptive tooth the irritation of the foreign substance within the alveolar process may be such as

to cause proliferation of connective tissue cells and the formation c fibrous mass surrounding the tumor (Fig. 187).

These tumors are seldom very large, they grow very slowly, are p less, and at the site of a non-erupted tooth.

In the treatment the tumor should be excised.

Clementomes.—These growths may represent a thickening of the mentum covering the fang of the tooth, converting it into a more or les regular mass of bone. In other cases the entire capsule may be implic with more or less thickening and irregular deposits of lime salts. In tl cases where the hypertrophy is confined to the fang the growth may be cumscribed, taking the form of an exostosis, or the growth may involve roots of two or more adjacent teeth, locking them together and produ a tumor of considerable size.

In some cases the entire capsule is affected, thickened and subseque ossified; the tooth is then embedded in a mass of cement tissue.

Compound Follicular Odontomes are the result of thickening and cal cation of the tooth capsule. Within these growths clinging to the capsule frequently to be found numerous small, ill-formed rudimentary teeth, kn as denticles. There may be but one of these rudimentary teeth, or sev hundred. These denticles may be composed of cementum, of dentine of all the three elements of the normal tooth, namely, cementum, der and enamel. They usually make their appearance in childhood during period when the permanent or deciduous teeth are developing.

Radicular Odontomes have their origin from the papillæ of the tc They ordinarily occur after the crowns have completed their developm but are rare tumors. In the cases thus far observed the growths l reached a considerable size and were very hard and irregular. In s cases the growths were attended with severe and even excruciating and profuse suppuration.

Composite Odontomes are tumors which are composed of all the ments of a tooth germ, enamel, papilla, and follicle. They seem to bear resemblance to normal teeth, and often are of very considerable size. C sionally the germs of two or more teeth consolidate to form a tu Many cases have been associated with severe suppurative processes.

Diagnosis of Odontomes.—Bland Sutton in his work on tumors, I makes the astonishing statement that up to that time not a single odont excepting dentigerous cysts, had been correctly diagnosed before op tion. The majority have been mistaken for osteomata, necrosis or m nant tumors. If we take into consideration that in every case of odont barring the cystic forms, taking origin from the epithelial rests, or si cysts situated at the roots of devitalized teeth, there has been a failur eruption of one or more teeth, this will aid us materially in making a rect diagnosis. While this statement is not absolutely correct, in supernumerary teeth may be the cause of these growths within the ja will for all practical and clinical purposes hold good.

Odontomes with few exceptions occur in childhood or young a life. They are of slow growth, usually requiring years in order to pro any considerable expansion of the jaw. They have been mistaken for e toses and osteomata, but this should not occur, as the latter are firml

tached to the bone and are immovable. They are frequently mistaken for necrosis. Necrosis comes on suddenly, progresses rapidly to suppuration, and then gradually declines until the separation of the necrosed bone. They have also been mistaken for sarcomatous growths; but in these the teeth will all have been erupted. The myeloid sarcomatous growth is ushered in with toothache, the teeth taking root in the infected region becoming loosened, and when extracted the trouble does not cease, but the jaw slowly expands, the process being slow but still more rapid than the growth of an ordinary odontome. There will also be more or less discharge from the alveolar cavity from which the teeth have been drawn. This process becomes painful and the adjacent tissues are swollen in consequence of infection.

Fig. 188.—Capillary angioma.

PROGNOSIS.—Odontomes being benign growths the prognosis is good.

ETIOLOGY.—The solid wall of epithelial cells which takes origin from the under surface of the oral mucous membrane is projected into the tissues beneath. From this wall many small columns of epithelial cells are sent out. These columns correspond to the future teeth. As a rule these cells are subsequently absorbed after having undergone fatty degeneration, but they may remain as dormant nests sequestered within the tissues until irritation or inflammation excites them to proliferate. There are a few cases on record in which epithelial growths have occurred in the jaw as the result of irritation or inflammation of these sequestered cells.

Cystic and solid odontomes taking origin from these cells, are infrequent, while epitheliomata, malignant in character and having the same origin, are practically unknown. Dentigerous cysts are apparently caused by errors in the development of a tooth and a failure in its eruption. Simple cysts are the consequent of devitalization of the root or portion of the crown, which then acts as a foreign body within the tissues.

Fibrous odontomes, cementomes, compound follicular odontomes and radicular odontomes, are very similar processes, as all have to do with the capsule or papilla. The tumor is caused in either case by an excessive growth in the capsule, in which, in some cases, lime salts are deposited in more or less regular order. These tumors are largely due to irritation or inflammation within the capsule or papilla.

Fig. 189.—Microscopical section of a capillary angioma.

TREATMENT.—The odontomes being benign in character do not require for their removal excision of the jaw. The alveolar portion of the jaw in which the tumor is situated may be excised, but very frequently all that is necessary is an incision, the removal of a tooth and the curettement of the cavity.

ANGIOMATA.

These tumors are caused by an abnormal formation of blood vessels, either capillaries, arteries, veins, or even blood spaces. The genus is divided into four species: First, capillary angiomata; second, arterial or venous angiomata; third, cavernous angiomata, and fourth, plexiform angiomata.

CAPILLARY ANGIOMA.

(Mother's Mark.)

This form of angioma is with a very few exceptions congenital. It is of frequent occurrence. It has been held that nearly thirty per cent.

of all children when born are affected with this form of angioma. The growth usually implicates the skin or a mucous membrane, and is often situated upon the face or scalp. It also frequently occurs upon the neck and chest,—in fact there is no part of the surface of the body which is entirely exempt (Fig. 188).

HISTOLOGY.—In their histology the capillary angiomata are represented by a growth of capillaries and venules within the corium; they occasionally extend beneath the corium into the subcutaneous tissue (Fig. 189).

SIZE, FREQUENCY AND APPEARANCE.—Capillary angiomata may be single or multiple, and in size varying from those not larger than small specks or grains of red pepper, to one which covers a considerable part of the face, or a portion of a limb. The border of the capillary angioma is usually very slightly, if at all, elevated above that of the normal skin. Its surface is usually smooth and covered with normal epidermis. Occasionally this epidermis collects in slight elevations, forming small excrescences which fall off spontaneously, or as the result of a traumatism, giving rise to slight hemorrhages. The color of these angiomata varies from bright red to a Port wine or venous color, depending very largely upon the amount

Fig. 190.—Congenital angioma confined to the skin. Child 1½ years of age.

of tissue overlying the vessels, as well as upon the character of the blood, venous or arterial, which penetrates the nævus. The color is increased by the dependent position of the parts, or by any condition mechanical or emotional which increases the amount of blood within the growth. The border is usually well defined, the discoloration of the angioma being separated from the normal skin by a clear and abrupt line. As a rule the capillary angiomata are congenital and show little disposition to increase or lessen in size.

ARTERIAL AND VENOUS ANGIOMATA OR TELANGIECTASIS.

These tumors are either congenital or make their appearance within the first few months following birth. It is probably true that in most cases they are really congenital but of such insignificant size as to escape early detection.

The arterial or venous angioma consists of a conglomeration of small arteries and veins, joined together by a quantity of areolar tissue, in which there is often more or less fat. The vessels are possessed of an endothelial

lining, outside of which there is a more or less thickened fibrous coat. While primarily, or subsequently, implicating to some extent the skin, these growths are situated usually in the subcutaneous tissue. They make up a very considerable tumor which projects decidedly from the surface, often causing a bright red or bluish discoloration of the skin. They present on palpation a somewhat soft and irregular surface. They can be made largely to disappear by pressure. They are painless and usually of irregular growth (Fig. 190).

CAVERNOUS ANGIOMA.

This is one of the most frequent forms of angioma which come to the surgeon's attention. They are congenital but may not be observed until a

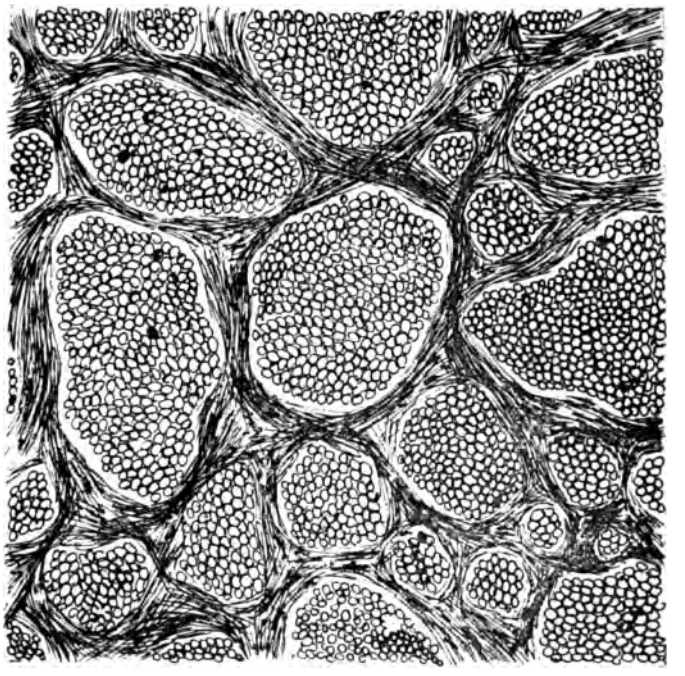


Fig. 191.—Microscopical section of a cavernous angioma.

few weeks or months after birth. They usually come under observation as subcutaneous growths, situated either upon the face, neck, chest, hands or feet, although they may be found and do occur upon every portion of the body. When first discovered, a few weeks after birth, there is usually a slight elevation of the skin with perhaps here and there enlarged veins leaving the area in radiating lines and disappearing within the healthy tissues some distance from the site of the growth. Beneath the skin is to be felt a somewhat soft, irregular and perhaps ill-defined mass, which in some instances might easily be compared to a bunch of earth-worms. In their growth they are usually markedly progressive, increasing in size from month to month and often from week to week. They are situated not only

subcutaneously, but are also found within the bones, the brain, the post-bulbous tissue, and internally within the liver, kidneys and spleen. They are also found in the mucous membrane of the nose and pharynx.

HISTOLOGY.—They are composed of freely inter-communicating spaces, lined with endothelial cells, and bounded by thin layers of fibrous tissue. Occasionally they present dilated vessels as well as blood spaces (Fig. 191).

Plexiform angiomata have already been considered under the head of aneurism.

ETIOLOGY OF THE ANGIOMATA.—Congenital conditions play a very considerable part in the production of the angiomata. They are found frequently at the site of the branchial arches of either the face or neck, as well as at other fissural openings which are permanent in character. Injuries and mechanical causes unquestionably play a part in the production of these tumors.

DIAGNOSIS.—Angiomata are ordinarily easily diagnosed. The nature

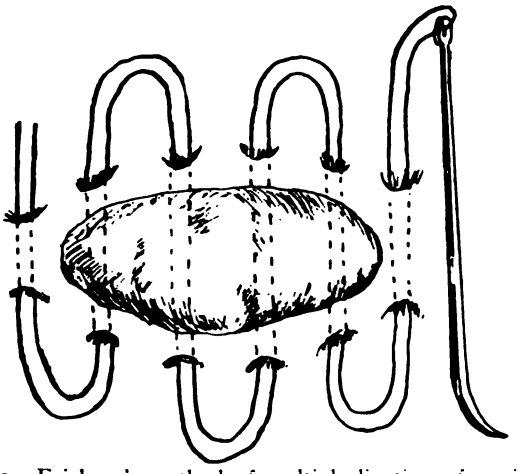


Fig. 192.—Erichsen's method of multiple ligation of angiomata.

of the nævus, or mother's mark, is apparent at a glance. The telangiectasic or cavernous form, though difficult or even impossible to differentiate without microscopical section, are nevertheless easy of diagnosis insofar as being angiomata is concerned, providing they are accessible to inspection.

PROGNOSIS.—Angiomata are benign growths and ordinarily do not affect the health, well-being or life of the individual. It is, however, true that in some exceptional cases, as the result of ulceration or injury, excessive or even an alarming hemorrhage has occurred. In other cases as the result of sepsis, thrombosis and embolism may occur, resulting in pyemia or even death.

TREATMENT.—Capillary angiomata, if of large size, are usually beyond remedial measures. When situated upon the face they are treated for cosmetic effect. When small and spider like nævi are encountered, destruction of the central vessel by ignipuncture, electrolysis or the application of the point of a toothpick dipped in nitric acid will usually be curative of the condition. Port wine marks, situated upon the face, may often

be relieved of much of their redness and unsightliness by the destruction many of the capillaries through electrolysis or ignipuncture. When blemish is small the briefest application possible of the flat surface of blade of the Pacquelin cautery will often destroy the vessels and leave no ing behind but a white and almost invisible scar.

TREATMENT OF ARTERIAL, VENOUS AND CAVERNOUS ANGIOMATA.— not situated upon the face excision is perhaps the best method of tre ment of this class of tumors. The growth is enclosed by two semilu incisions, which go outside of the tumor, through healthy tissue, and do to the muscles beneath. The growth is then quickly removed. Ordina not more than two or three blood vessels will require ligation. When si ated upon some portion of the face, and especially if on the eyelids, a the growth is large and prominent, excision cannot be practised withou subsequent plastic operation, and perhaps severe deformity. In such ca multiple ligation according to the method of Erichsen, is often the m advisable procedure to follow (Fig. 192). It is attended by little loss

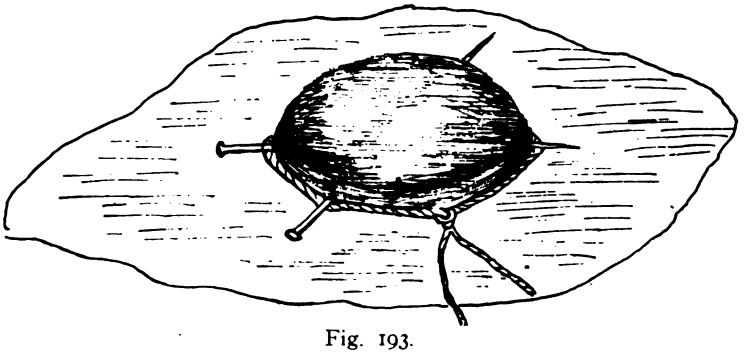


Fig. 193.

blood, and if the part be kept subsequently aseptic, but little pain and alm no suppuration results, and from the ligation there is very slight subsequ deformity. Recently Dr. John A. Wyeth has recommended injecting b ing water into these growths. This produces, if successful, coagulation the blood within the vessels, and arrests the circulation, the tumor shrink and disappearing. In some cases the method is followed by the happi result, a cure being effected without any scar. In others, so far as my o experience goes, it is almost impossible to arrest the circulation within growth and to effect a cure by this means. In these either excision or m tiple ligation should be resorted to (Fig. 193).

MYXOMATA.

The myxoma is a tumor composed of connective tissue cells betw which there is a homogeneous or slightly granular gelatinous substan The myxomata correspond very closely in their structure with the Wh tonian jelly of the umbilical cord, and to the vitreous humor of the e If the cellular elements of the myxoma are very sparse the tumor will almost translucent, extremely soft and seemingly cystic in character; w on the contrary, if the cellular elements are numerous the tumor will h a whitish or milky appearance, be much harder in consistency, and tra

mit but little light. The cells may be stellate, spindle-shaped or round, or a mixture of these forms may occur in the same tumor.

The myxoma ordinarily has about the consistency of thin jelly; its substance is tremulous and in appearance resembles the pulp of the grape. It refracts light freely, thus giving the surface a glistening appearance. Myxomatous tumors taking origin from the mucous membranes often contain some and even much glandular structure. When the tumor takes origin from the connective tissue spaces, it usually has a thin, delicate, fibrous covering; when subcutaneous or situated within the corium, it may have a normal skin covering or only a coating of epidermis (Fig. 194).

SITUATION AND FREQUENCY.—Myxomatous tumors occur most frequently within the nose, especially from the Schneiderian membrane covering the middle meatus, and from the middle turbinated bones. Not in-

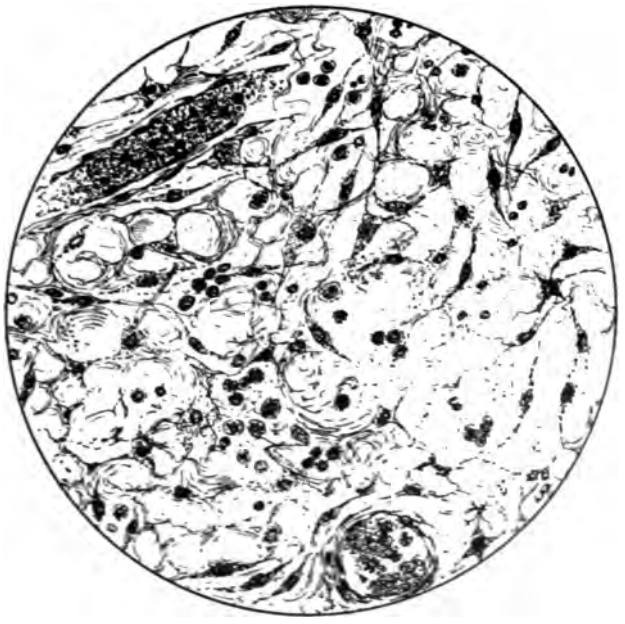


Fig 194.—Myxomatous tissue under a high power

frequently they also occur in the various cavities connected with or adjacent to the nose, especially the antrum of Highmore, the frontal sinus and in the subcutaneous tissue and skin in the mammary glands, salivary glands and testicles (Fig. 195).

APPEARANCE AND SIZE.—Myxomata occurring as nasal [illegible] may be as small as a bird shot, or of such size as to completely fill the nasopharynx. The myxomata being enclosed within a capsule [illegible] distinct form, and are most frequently pear-shaped. They are [illegible] soft, trembling like masses of gelatinous substance, more or less translucent, and of a pearly or a slightly milky appearance. They are soft and may readily be indented with a probe, and are freely [illegible]

While nasal polypi occur singly, they are more frequently found as multiple tumors.

SYMPTOMS.—Myxomatous tumors occurring in the nasal cavities frequently cause irritation with an increase of the normal secretions. Perhaps one of the most pronounced symptoms is frequent sneezing, or violent attacks of sneezing, attended by a profuse, watery discharge. There is often a pronounced and disagreeable burning and itching within the nose, caused by the increased amount of fluid oozing through the mucous membrane. With the increased size of the growth there is more or less stenosis of one side, or it may be of both sides, providing the growths are situated in both nasal passages. Not infrequently as a result of infection a mucopurulent discharge occurs, which may be offensive in character, and lead to infection of the adjacent cavities. Asthma and hay fever are also accompaniments of nasal polypi. In cases of pronounced nasal stenosis, laryngitis or bronchitis may occur as secondary conditions. The tone of

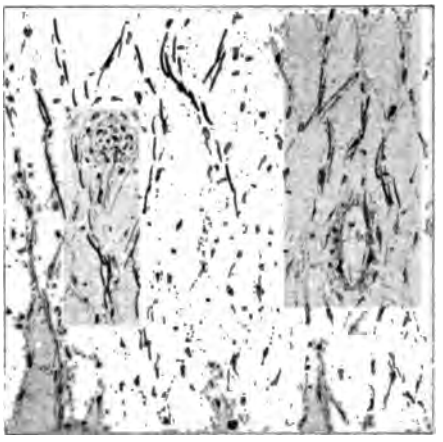


Fig. 195.—Nasal polypus. A myxo-fibroma.

the voice is also altered, the patient acquiring a more or less nasal tone (or dead voice), in consequence of the obstruction of the nasal fossæ.

DIAGNOSIS.—The above mentioned train of symptoms should lead one to examine the nasal fossæ, when a correct diagnosis can be made. Inspection of the nasal fossæ should be done by means of a good light which is thrown from a head mirror through a speculum made to illuminate the parts. The polypus may then be seen, if present, as a smooth, pear-shaped, moist, glistening, pearly, slightly-translucent, freely-movable growth which is readily indented with a probe, which is painless, and which often changes its position on inspiration and expiration.

PROGNOSIS.—Myxomatous tumors are benign growths which under ordinary conditions will not produce metastatic deposits or recur after complete removal, or affect, except mechanically, the health, comfort or well-being of the individual. It is quite true, however, that they may, in consequence of their producing a stenosis of one or both nasal fossæ, cause mouth-breathing, with laryngitis or bronchitis as a sequence, or in conse-

quence of infection cause septic inflammation within the cavities adjacent to the nose, or perhaps seriously interfere with hearing. It is also seemingly true that there is in myxomatous tumors a certain tendency towards malignant change, whereby a benign tumor as the result of apparently continued irritation or severe traumatism, or the result, perhaps, of unskilled efforts at removal, or when complete eradication has not been effected, takes on malignant characteristics (Fig. 196).

TREATMENT.—Before any operative measures are undertaken looking to the removal of neoplasms within the nose, the nasal cavity should be rendered as nearly aseptic as possible, by the use of antiseptic sprays or douches. Myxomatous tumors when causing pressure, irritation, or functional disturbances, should be removed. The means perhaps best adapted

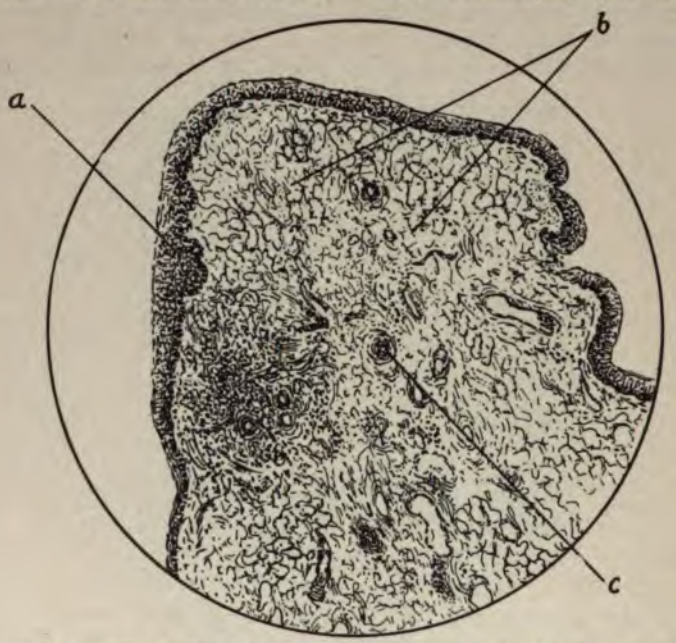


Fig. 196.—Nasal polypus (mucous) under a low power. a.—Epithelium. b.—Stroma. c.—Blood vessel.

for the use of the general surgeon or general practitioner in the removal of nasal polypi is the cold wire snare. A most excellent instrument is Bosworth's snare. The loop may be slipped over the polypus by carrying it along the nasal septum up toward the middle fossa or middle turbinated bone, where it is gradually tightened by drawing upon the cross-bar, and the pedicle divided, or the growth evulsed. One after another of these polypi may be removed in this manner, packing the nostrils between the removals for the purpose of arresting the hemorrhage.

MYOMATA.

A myoma is a benign tumor composed of muscular elements which are usually bound together in bundles by connective tissue. The connec-

tive tissue may be interspersed between the muscular elements and make up a considerable part of the growth.

Myomata are divided into two classes: 1st, those composed of striped muscular tissues, and known as rhabdomyomata; and, 2d, those composed of unstriped muscular tissue and known as leiomyomata. Tumors consisting of striped muscular tissue are of rare occurrence and usually congenital in origin.

Myomata composed of unstriped muscular tissue are of frequent occurrence and consequently of great interest and importance to the surgeon. They may and do occur wherever unstriped muscular tissue is found. They have most frequently been observed taking origin from the uterus, prostate gland, Fallopian tubes, ovaries, ovarian ligaments, round ligaments, from the pelvic peritoneum immediately adjacent to, or making up, the broad ligaments, from the œsophagus, gastro-intestinal canal, bladder, scrotum, walls of the arteries, and from the skin, nipples and breast (Fig. 197).

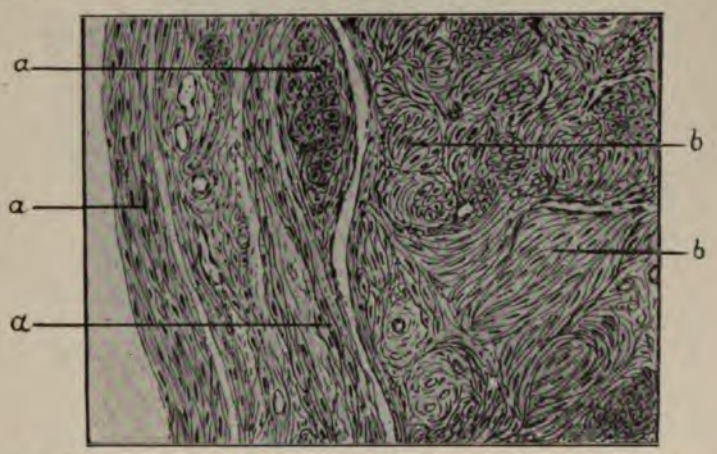


Fig. 197.—A microscopical section of an intra-mural myoma showing the uterine wall. a.—Uterine wall. b.—Tumor.

Myomata have on account of their color, hardness, situation and general appearance, been mistaken for fibromata. Macroscopically they show, except in the rarest instances, nothing upon section which would indicate that they were composed of muscular tissue, being usually hard, grating under the knife, showing a large number of whorls and presenting a dense grayish or whitish appearance, which is seemingly far more characteristic of fibrous than muscular tissue.

MIXED FORMS.

In myomata the muscular tissue is always mixed with more or less of fibrous or connective tissue, but in a large number of these cases this is not sufficient to change the character of the growth. When the fibrous tissue is very considerable, perhaps equalling or exceeding the muscular, the growth should be termed a myo-fibroma. The characteristics of the tumor, insofar

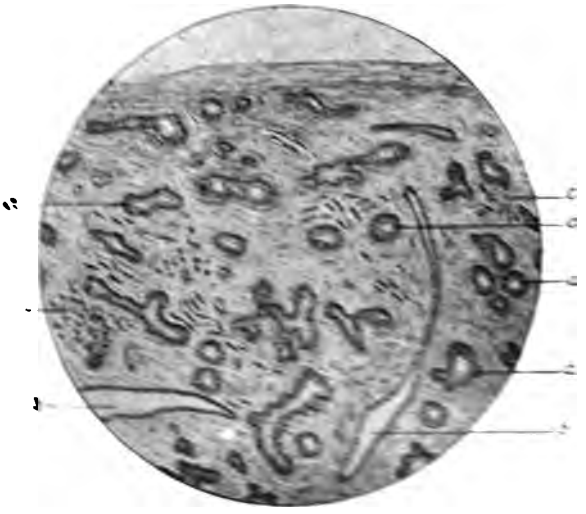
as contour, hardness, appearance on section, and rate of growth are concerned, are not changed by this admixture.

MYO-ADENOMA.

It is rare to find glandular tissue in myomatous tumors. The glandular tissue may have its origin from the glands or epithelial outgrowths of the overlying mucous membrane, or they may be the result of outgrowths of the vestiges of embryonal tissue (Fig. 108).

MYO-CYSTOMA.

The myomata are frequently cystic in character. The cyst may be the result of an œdematous condition of the lymphatic spaces in consequence of inflammation or irritation, or the result of some obstruction of the venous



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NEUROMATA.

Neuromata have been divided into the true and false. The former a still further divided into ganglionic, myelinic and amyelinic. True neu mata are of extremely rare occurrence, and it has been claimed by ma clinicians and pathologists that there are no neuromata in the true app cation of the term. A neuroma proper must be composed largely new nerve elements; there must have been a proliferation of ner tissue, causing at least a part of the new-growth, and it is quite i material whether this new tissue be nerve fibres or ganglionic cells, or admixture of the two. At the present time it seems to be well establish that true neuromata, or tumors due to the proliferation of nerve tiss do really exist and are occasionally encountered. They may be situat wherever nerve tissue is found, and they seemingly most frequently ha their origin from the sympathetic nervous system. Ganglionic neuroma or nerve tumors made up at least in part of ganglionic cells, have be

Fig. 199.—A cyst formed in an intra-mural myoma as the result of degenerat change.

found taking origin from the thoracic, lumbar, hypogastric, adrenal a solar plexus of the sympathetic system.

Neuromata composed of nerve fibres have been found in connecti with syringomyelia, in tabes, and also as multiple growths situated wit the skin.

The true neuromata seem especially liable to affect children and you adults, and while they are ordinarily of slow growth and seldom reach a very considerable size, some have been reported to have attained large dime sions. They may be single or multiple.

FALSE NEUROMATA.

False neuromata are of comparatively frequent occurrence. They m be subdivided into the neuro-fibromata, the diffused neuromata, the ple form and the traumatic neuromata. The false neuro-fibroma is usually

small, fusiform growth situated upon a nerve. Histologically the growth is a fibroma and composed of fibrous tissue, taking origin in the perineurium or the endoneurium. The new growth is made up of fibrous connective tissue and is situated either upon the nerve, or the nerve fibres are separated and to some extent enclose the growth. These tumors when situated subcutaneously and if upon a sensitive nerve, are known as *painful, subcutaneous tubercles.* When thus situated they give rise, upon irritation, compression or exposure to cold, to intense radiating pain.

DIFFUSED NEUROMATA.

These growths are composed of a diffused thickening of the nerve sheathes, causing, it may be, numerous elliptical or spherical growths, or there may be a generalized enlargement of the nerves. These growths are usually encapsulated and well defined, but occasionally on the contrary their limits are not easily determined. While they may be few in number yet are occasionally extremely numerous. They are made up of fibrous tissue taking origin from the endoneurium, and are usually whitish in color and fine in texture. These growths are usually not very sensitive unless exposed to considerable pressure or irritation.

PLEXIFORM NEUROMATA.

These are usually congenital growths involving the subcutaneous nerves. They are most frequently situated upon the face and neck in connection with the fifth pair or cervicle nerves. The tumor is usually of a soft, gelatinous type and composed of a number of thickened, tortuous nerve strands, held together by connective tissue. In the plexiform neuromata, one branch or all the branches of a given nerve distributed to a certain area may become involved.

TREATMENT.—Any of the forms of neuromata, if unsightly or causing pain, or creating functional disturbance, should be removed. In the removal of a neuroma situated upon a motor nerve, the continuity of the nerve, if possible, should be preserved.

GLIOMATA.

A glioma is a tumor composed of neuroglia and is found in the cerebro-spinal centers, and in certain embryonal peripheral processes of the brain, namely the retina and the optic and olfactory nerves. Gliomata take origin only from the neuroglia, which is a supporting tissue confined to the cerebro-spinal axis and the above-named nerves. The neuroglia has the same embryological origin as the nervous system, namely the epiblast. The neuroglia has the characteristics of connective tissue; it supports, sustains and embeds the nerve fibres and cells; it has no active function. It combines with connective tissue in producing sarcoma and endothelioma, but never with epithelial cells, producing carcinoma.

The neuroglia when examined histologically is found to be made up of a variety of cells known as glia-cells. The smaller of these contain a single nucleus and the larger cells sometimes two or more nuclei. The cells are composed of a mass of protoplasm, which surrounds the nucleus and sends off protoplasmic fibres, which radiate in every direction (Fig. 200).

The gliomata occurring as they do in the brain and spinal cord, take origin from the neurogliar tissue. They are tumors which, at least in the brain, are of quite frequent occurrence, and are found with special frequency in the cortex. They may, however, occur in the white substance in the ganglia at the base of the brain, in the pons, in the medulla oblongata and in the spinal cord. They occur with special frequency in children and young adults, although they have been found in persons fifty years of age.

The gliomata have been divided according to their consistency into the glioma durum in which the cells are sparse and the growth hard, and the glioma molle, in which the growth is made up largely of cellular elements and is quite soft. There is also a third form, the glioma telangiec-

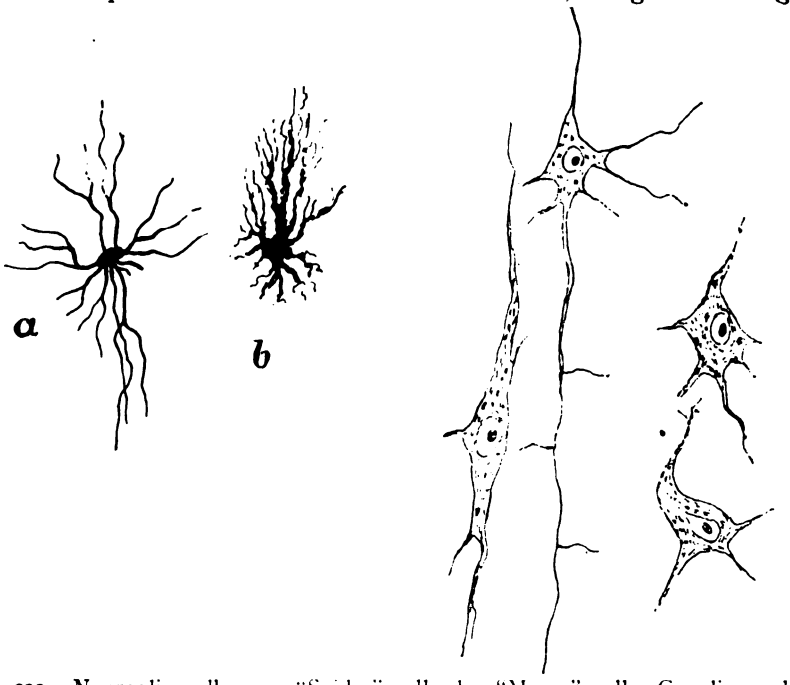

Fig. 200.—Neuroglia cells. a.—"Spider" cell. b.—"Mossy" cell. Ganglion cells.

taticum, in which there is an increase in the number and size of the blood vessels.

The gliomata are ordinarily not well defined. They are seldom, if ever, encapsulated, but on the contrary shade off imperceptibly into the adjacent tissue, where there is both a macroscopical and microscopical infiltration. The color of the gliomata corresponds to, but is usually slightly redder than, the adjacent tissue. In consistency they are usually slightly harder than the brain tissue, though they may be translucent and as soft as the vitreous, or as hard as the pons. They may be single or multiple, although they are usually single. They may be small, not larger than the end of the finger or as large as a good-sized orange. They grow slowly and do not interfere seriously with the nerve tracts, or produce symptoms of

symbols, is caused by the disturbance of the center of vision, situated in the occipital lobe.

Tumors may also be situated in the cerebellum, where they are likely to produce, in addition to the cardinal symptoms of brain tumors, excessive vertigo, vomiting, unsteadiness of gait, and incoördination of the muscles of the extremities.

In making a diagnosis of an intra-cranial growth, it is desirable, if possible, not only to determine that the growth is present, but its situation according to localizing symptoms, and also whether it is in the cortex or is subcortical, whether the growth is large or small, single or multiple, and its character. The great majority of gliomata situated within the cranium are cortical. If there is a loss of sensation, or hemiplegia, it is indicative of the growth being situated within the internal capsule. If the patient is suffering from multiple growths, the different areas affected show the results of the irritation.

It is also necessary to determine as nearly as possible the size of the growth. This can only be told by the extent to which the intra-cranial pressure has been altered, by the severity of the symptoms, and by the fact that a growth having started in one center has progressed from there to, and invaded, distant centers. The number of adjacent areas implicated will indicate approximately the size of the neoplasm. The character of the growth must also be determined. The gliomata if possible must be differentiated from tubercular growths, which are extremely common, and which usually occur in patients manifesting symptoms of tuberculosis in other portions of the body. They must be differentiated from cysts due to poro-encephalitis which is usually the result of infantile inflammation or hemorrhage, and which is often associated with a marked degree of paralysis.

Gliomata of the brain should also be differentiated from syphilitic gummata. Here the diagnosis will be aided by the patient's history. They must also be differentiated from carcinomatous growths, which in the brain are also secondary and follow a carcinomatous disease of some other organ. From the sarcomata they cannot ordinarily be distinguished and with these growths they are also often combined.

TREATMENT.—It is stated by Von Bergmann that no more than ten or fifteen per cent. of the gliomata are operable. This may be due to their location, size, or to their non-encapsulation. Operations may be undertaken in the case of gliomata for the purpose of relieving the distressing symptoms, or for the purpose of curing the disease. When the symptoms of intra-cranial pressure are pronounced, and if the situation of the growth is such that its removal is known to be impossible, a trephining is done for the purpose of relieving in part the pressure, and is often of the greatest advantage to the patient. In opening the skull the osteoplastic method is preferable, and it is most desirable to have a free opening. If the tumor can be located and it is situated within the cortex and its size be not too great, it can be removed, and if encapsulated it can be readily shelled out. It is most desirable to remove the growth entirely if possible. If the growth is more or less diffused the surgeon must with a dull spoon or curette go wide of the growth into the surrounding healthy tissue. After removal hemorrhage is controlled by ligature or by iodoform tampon.

and often almost continuous. The site of the pain often corresponds to the situation of the tumor. Another symptom which is nearly as constant is dizziness or vertigo, and by vertigo is meant that which is due to disturbance within the brain and which has no connection in any way with the condition of the stomach. It is cerebral in character. Vertigo in severe cases is almost constant, very distressing and may be present not only when the patient is standing or sitting, but also when he is lying down. Nausea and vomiting are also frequent symptoms, and these are likewise cerebral in character. A fourth symptom of very great importance in the diagnosis of intra-cranial growths is choked disks, papillitis, neuritis, or atrophy of the optic nerve, which is supposed to result from an increase of the intra-cranial pressure, or to a disturbance of the venous return circulation. The four cardinal symptoms then of brain tumor are headache, vertigo, vomiting and disturbance of the circulation in the optic nerve, producing choked disk.

Special symptoms depend upon the particular relations and upon the situation of the growth. Nearly three-fourths of all intra-cranial neoplasms being situated in or near the motor areas, will in their growth create disturbances of these areas which will manifest by contraction or paralysis of the muscles supplied by the peripheral nerves. Of course it is to be understood that the symptoms will vary with the motor region implicated. Tumors of the motor areas are then not only attended with headache, vertigo, vomiting and choked disks, which are the usual symptoms of intra-cranial growths, irrespective of their situation, but they have special symptoms depending upon the irritation of the motor areas. There may be primarily a feeling of numbness confined to the finger or toe, or a limited muscular area, but sooner or later there is likely to be a disturbance of muscular contraction in the form of spasms.

The symptom of special importance of tumors of the occipital lobes is hemianopsia, or blindness in one-half of the field of vision of one or both eyes. Hemianopsia usually indicates a lesion of the cuneus of the same side.

Tumors in the temporal region while presenting less marked cardinal symptoms than in the other areas, do produce a condition of special importance in a diagnostic sense, and that is aphasia or disturbance of speech. In considering the different forms of aphasia one must keep strictly in mind the area which dominates that particular form of speech interfered with. In motor aphasia the patient misnames objects seen. He may be and probably is aware of his error, but he cannot correct it. In this form of aphasia the process is usually situated in the third frontal convolution, in the Island of Reil, and in the tissue situated between these two centers.

The form of aphasia known as agraphia, in which the patient is unable to write in consequence of his loss of certain memories which enable him to exercise his finger movements, is situated in the posterior part of the second frontal convolution. Word deafness or sensory aphasia, in which the patient does not understand spoken language, may be caused by a tumor situated in the posterior portion of the first temporal convolution. Word blindness in which there is a loss of memory of printed or written

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ADENOMATA.

An adenoma may be defined as a tumor growing from an epithelial-cla surface and having the structure of a secreting gland. It differs, howeve from normal glandular tissue in that it has no function, ordinarily produce no secretion, and is without pervious ducts. Adenomata are benign growth and when taking origin from the interior of a gland, are distinct and wel defined, being enclosed and separated from the adjacent structures by distinct fibrous capsule. When taking origin from the cutaneous or mucou surfaces, they usually assume the characteristics or take the appearance of warty or villous growths, and are then ordinarily pedunculated. Th adenomatous growths may be single or multiple. When situated in th gastrointestinal canal they are not only multiple, but a dozen or more ma be found in the same individual. Situated in the mammary gland the are also occasionally multiple and not infrequently bilateral. In size, as rule, they are small, not larger than a hickory-nut or walnut, but occa sionally, as in the breast and ovary, they have reached the size of an adu

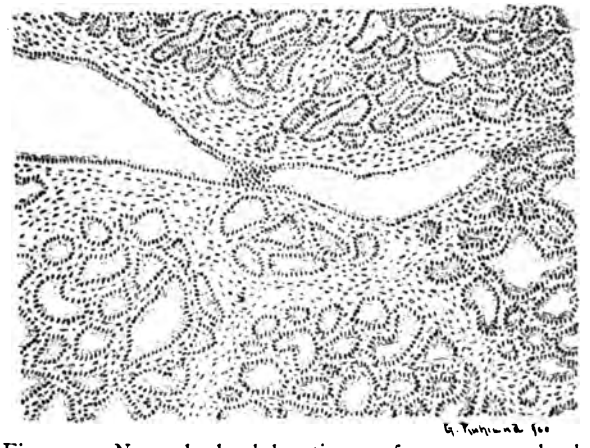

Fig. 202.—Normal glandular tissue of mammary gland.

head. Their rate of growth is usually slow, requiring often several year in order to attain any considerable size. The seemingly slow growth, how ever, may be changed by extraneous conditions, the principle of which i the formation of cysts due to dilatation or coalescence of adjacent acin The cysts not infrequently increase quite rapidly in size, and thus produc an apparently rapid growth of the tumor.

In their histological structure they differ very markedly, and whil they easily conform with reasonable precision to the gland in which o from which they take origin, this is not necessarily the case. An adenom taking origin from the mammary gland is likely to resemble the structur of that gland. The same is true of one taking origin from the prostate o ovary (Fig. 202).

DIAGNOSIS.—The rate of growth of these tumors is slow, several year being required for them to reach any considerable size. They are smoot or lobulated, distinctly encapsulated and separable from the adjacent tis

sues. When situated in the breast they move with some freedom, slipping under the fingers, produce little or no spontaneous pain; are situated ordinarily almost directly beneath the skin; do not interfere with the functions of the gland; do not cause metastasis or interfere with the general health or comfort of the individual (Fig. 203).

PROGNOSIS.—Being benign growths the prognosis is good.

TREATMENT.—The treatment of adenomata conforms to that of other benign growths. If they are of very considerable size, unsightly, or causing pressure symptoms, they should be removed (Fig. 204).

CYSTS OR CYSTOMATA.

A cyst may be defined as a sac composed of fibrous tissue and lined with one or more layers of epithelial or endothelial cells, which surround and enclose a cavity containing a fluid or semi-fluid substance.

Fig. 203.—Adenoma of thyroid gland.

The cysts perhaps vary more in their construction, contents, situation and methods of development than any other class of tumors. The contents of a cyst will depend very largely upon the structures in which or from which the cyst wall has been developed. Cysts of the sebaceous glands represent in their contents the changed secretions of these glands. Mucous cysts, or cysts springing from mucous membrane, are filled with a mucoid substance. In a pancreatic cyst the contents conform closely to the pancreatic fluid. Serous cysts contain serum. A hemorrhagic cyst contains blood more or less changed or disorganized. Dermoid cysts often

contain in their interior products which are normal to the epiblast or hypoblast, such as hair, bone and teeth. Galactic cysts contain milk. When the gall bladder, kidney, or ureter are converted into cystic tumors they contain more or less bile or urine.

The contents and characteristics of a cyst then, depend almost entirely upon its situation and upon the character of the cells which line its interior, whether these normally produce mucus, bile, sebaceous material, or pancreatic fluid. The contents of a cyst may undergo certain changes; that is, they may become infected and converted into pus, as occurs in the suppurative ovarian cyst, suppuration of the gall bladder, suppuration

Fig. 204.—Adenoma of ovary.

of the sebaceous cysts and in pyonephrosis. The contents may also be converted in consequence of inspissation into a more or less solid mass. This takes place in the sebaceous cyst and in the gall bladder. The character of the contents may also be changed in consequence of hemorrhage into the cyst cavity. This is seen with especial frequency in ovarian cysts, where the fluid is thin and transparent, but may become in consequence of hemorrhage dark brown in color, somewhat thickened and very turbid in character.

The lining of a cyst may consist of a single layer of columnar, cuboidal, or ciliated epithelium; or the epithelial lining may be stratified, or while usually consisting of a single layer, it may be collected at various points into more or less irregular heaps. Some cysts, especially the congenital serous cysts, are lined with endothelium derived from connective tissue

plates, or, as is the case with hemorrhagic cysts, the wall may be made up, primarily at least, of connective tissue rendered more or less compact by pressure and irritation, and without a distinct endothelial lining, or only such as it derives from the connective tissue. In the case of a cystic adenoma numerous follicles are often found upon the interior of the cyst wall, or a budding or proliferation of the lining epithelium may take place, forming new acini which are, with the follicles, the occasion of the formation of multilocular cysts. The cyst wall may present a beautiful pearly-white color, be almost transparent, or be milky, opaque and dark in appearance.

The cyst stroma is made up of fibrous tissue which is at times very thin, scarcely thicker than tissue paper, made of but a single layer or a closely set mesh-work of fibres, or consists, as the result of irritation and pressure, of a wall measuring one-quarter of an inch or more in thickness.

Cysts are unilocular or multilocular. The unilocular cyst represents a single cavity. It may be the result of the dilatation of a duct, an acinus or a tubular gland. The unilocular cyst may occur in connective tissue spaces as the result of hemorrhage or serous exudate, or it may be due to inclusions of the epiblast, or the result of congenital defects of development. They may occur in free peritoneal spaces which are normally free from fluid, or they may be found in hollow organs or inclosed peritoneal cavities. They may be due to the absorption of adjacent walls and the coalescence of several cysts.

A multilocular cyst represents several cavities bound together by a fibrous investment. They frequently take origin from glandular structures. They are in many instances cysto-adenomata. Their multilocular character often results from the budding or proliferation of the epithelial lining of a single cyst; in consequence of which and as a result of the degeneration and absorption of the center of the bud or process, hollow acini and subsequently cystic cavities are formed. In situations where there are many solid epithelial columns, and especially if these remain in the tissues as embryonal vestiges, as occurs in the jaw, in the production of the enamel of the teeth, in the ovaries in the production of the Graafian follicles, and in the testicles, these columns may be the site of the formation of cysts.

Cysts have been divided into

1. Retention cysts.
2. Tubulo-cysts.
3. Hydrocele.
4. Glandular cysts.
5. Congenital cysts.
6. Cysts due to parasites.
7. Miscellaneous cysts.

Of the retention cysts the sebaceous are perhaps the most frequent. They are most often situated upon the head, but may occur upon any portion of the cutaneous surface. They are caused by the narrowing or closure of the duct, or in consequence of the secretion of the gland becoming inspissated. The condition is hereditary in some instances, occurring not infrequently in several members of many successive families. The tumors

may be single, but they are very often multiple—half a dozen or more not infrequently occurring within the tissues of the scalp. In size they vary greatly. They may not exceed that of a pin's head, or they may attain the dimensions of a hen's egg. They are directly connected with the skin through their duct, and as they increase in size they become attached to and immovable from the skin over a considerable surface. They may occur as round, reasonably smooth, semifluctuant growths, situated more or less subcutaneously. They not infrequently become inflamed, as the result of an injury or infection, and occasionally suppurate and discharge their contents, leaving a fistulous tract which often does not heal, but continues to discharge pus and sebaceous material. Such a fistulous opening or ulcer may become malignant, or the sebaceous material and inflammatory exudate made by adhering to the opening produce a horn of greater or less size (Fig. 205).

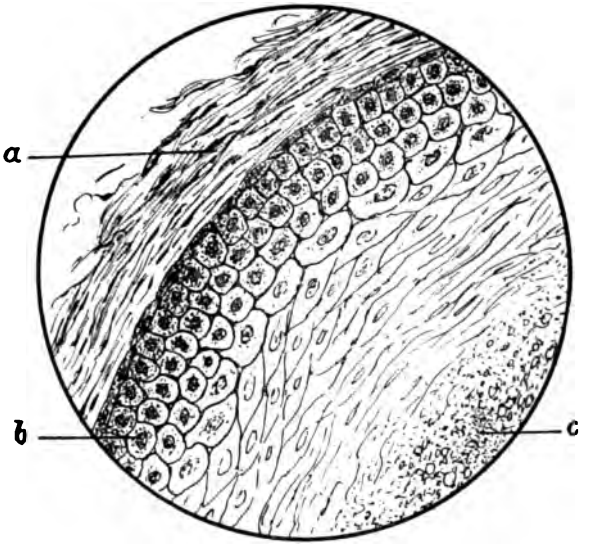

Fig. 205.—Sebaceous cyst. a. Thin layer of connective tissue, forming wall. b. Thick layer of cuboidal epithelium, becoming flattened and ceasing to stain towards c. c. Contents of cyst, consisting of products of fatty epithelium, viz., cholesterin and amorphous débris.

Diagnosis.—This rests largely upon the fact that they are small, circumscribed, elastic, semifluctuant and usually distinctly elevated tumors, which are inseparably connected with and immovable from the skin.

Treatment.—The parts should be thoroughly asepticized, when the skin and tumor are transfixed with a knife and divided; the walls of the cyst are then seized upon either side with forceps, and the cyst wall shelled out. It is necessary that the entire wall be removed in order to prevent recurrence. In cases in which infection and suppuration have taken place, the cyst wall will be so friable that it cannot be extracted with forceps. In these cases the cavity should be thoroughly curetted in order that the cyst wall may be completely removed. The cavity may then be drained.

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pain or special disturbance other than the inconvenience incident to its size. In this situation the growth is known as a ranula, and often has one or more large veins coursing over its surface.

These growths require the same treatment that is accorded to mucous cysts, namely, cutting away the free portion and cauterizing that part of the sac which remains, taking care, however, not to wound the adjacent veins.

PANCREATIC CYSTS.

Pancreatic cysts may be due to obstruction of some portion of the pancreatic duct, but probably more frequently they are the result of hemorrhage into the gland. They may follow injury or wounds of the pancreas. The cyst may be of slow or rapid growth, it is usually globular and situated over the site of the pancreas, it may be so tense as to feel like a solid growth, or present an indistinct feeling of fluctuation. These cysts may be resonant in some parts, owing to the transverse colon or stomach overlying them—and in other parts dull, the growths are usually quite elastic.

In the symptomatology there is usually gastro-intestinal disturbance, mental depression, localized pain, and there may be diabetes and changes in the feces. The fluid of a pancreatic cyst often contains urea, and will convert starch into sugar, emulsify fats, and may be translucent, or quite turbid.

DIAGNOSIS.—A positive diagnosis is often impossible without an exploratory incision.

TREATMENT.—Some pancreatic cysts are found distinctly pedunculated, in which case the pedicle may be ligated and the cyst removed. If sessile, as is usually the case, enucleation and complete removal of the cyst is usually inadvisable or impossible. The dangers incident to removal when the pancreas is more or less lacerated, are shock, hemorrhage, sepsis and fat necrosis. Unquestionably the safer and better method in sessile growths of the pancreas is to draw off the fluid, carefully protecting the abdominal contents from contact, opening the cyst, stitching it to the abdominal wall and establishing drainage. In a considerable number of this class of cases drainage effects a cure.

PAROVARIAN AND PAR-OOPHORON CYSTS.

In almost direct connection with the ovary during its development and lying in the mesovarium and mesosalpinx, are to be found the transverse tubules of the Wolffian body, which become the parovarium and par-oöphoron, and which open into the Wolffian duct. The parovarian and paroöphoron tissues seem to take on something like functional activity at puberty, and at this time cystic tumors taking origin from these tubules not unfrequently occur.

Parovarian cysts are practically unknown before the age of puberty, and are seldom found during old age. They are most frequently encountered betwen the eighteenth and thirty-fifth years of age. They may occur as small cysts, in which case they are usually multiple. When occurring singly they are almost without exception unilocular and may reach the size of an adult's head. They are situated beneath the peritoneum, within the folds of the mesovarium and mesosalpinx, and have a well marked pedicle;

or they grow down into the broad ligament and later rise into the abdomen being sessile in character; or, as not infrequently happens, they grow downward, separating the layers of the broad ligament and raising the peritoneum from the pelvic floor, pushing the uterus to the opposite side, perhaps separating the peritoneum from the posterior surface of the uterus, and projecting directly across the pelvis. In other cases they may so raise the peritoneum as to get under the sigmoid flexure, or the cæcum.

SYMPTOMS AND DIAGNOSIS.—In the growth of a parovarian cyst which reaches any considerable size there is usually more or less pain, which may be paroxysmal and severe, or be complained of as a dull, indifferent feeling of distress, with a sense of fullness and bearing down. There is usually more or less disturbance of menstruation, which is often too frequent excessive and even painful. The patients are usually young adults. The cysts are almost without exception unilocular or single. They are situated primarily within the pelvis, upon one side, close to the ovary, and produce in their growth displacement of the uterus, or it may be pressure upon the bladder or rectum. Upon examination they are found to be smooth, reasonably tense growths, which present a distinctive sense of fluctuation. If they are possessed of a pedicle they will be freely movable. They are of slow growth and they may perhaps be differentiated from ovarian cysts by the fact that they are of slower growth and occur in young adult life.

TREATMENT.—Removal of a broad ligament cyst is at times difficult and sometimes a hazardous undertaking. If the cyst has a pediicle it may be removed as easily as a pedunculated ovarian tumor. A cyst extending deeply into the folds of the broad ligament and situated entirely behind the peritoneum, especially one which has formed strong adhesions to the adjacent structures, is often shelled out with difficulty. Especially is this true if the cyst has been tapped one or more times, a practice, however, which should not be encouraged. After opening the abdomen, the vessels of the broad ligament are ligated at the uterine and pelvic walls and the peritoneum opened transversely over the most prominent portion of the tumor, being careful to avoid the important blood vessels. After opening the top of the broad ligament the fingers are swept about the growth, and separate it from its peritoneal covering. This procedure may be difficult or easy, depending upon the amount of precedent inflammation. If the cyst is of considerable size, and after one reaches approximately the base, the separation is rendered easier by withdrawing the cyst contents, then seizing the cyst wall with two or three very heavy, wide-bladed, strong forceps, and dragging on the wall as the enucleation is progressed with. These cysts are at times closely connected with the ureter, bladder or pelvic vessels Consequently the greatest care should be exercised in their enucleation After the enucleation of the cyst, the cavity should be carefully sponged dry and any bleeding vessels ligated, following which the surfaces of the broad ligament may be folded in upon themselves, and the cavity obliterated by an over-and-over continuous catgut suture.

CYSTS OF THE OVARY. CYSTO-ADENOMATA.

The ovary is situated upon the posterior surface of the broad ligament and is covered by peritoneum. The ovary is divided by histologists into two parts, the cortex, which is placed superficially and makes up about

one-third of the gland, and the medulla, which is situated centrally. The cortex is made up of a stroma which is composed largely of spindle cells and Graafian follicles. The immature follicle is lined by a single layer of low, columnar cells, while in those which are mature the epithelial lining consists of several layers of cells. Each follicle contains an ovum. During the first few days of fœtal life, the endothelial cells of the peritoneum at the site of the ovary become changed in character and converted into columnar cells. These cells occur in a single layer and subsequently grow into

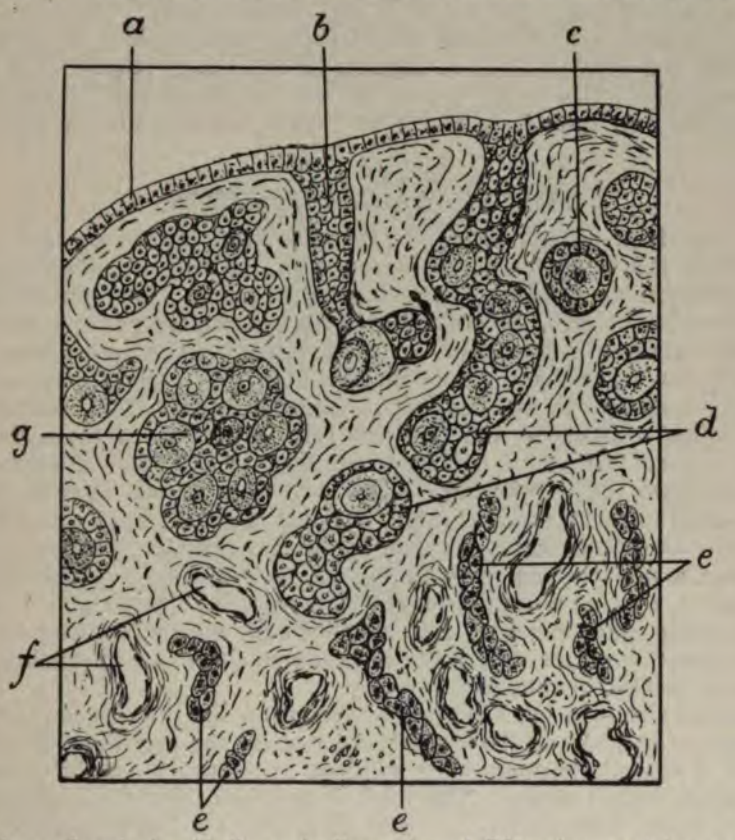


Fig. 206.—a. Germinal epithelium. b. Formation of Pflügerian egg-tube. c. Young, newly-formed follicle. d. Constriction of longer egg-tube to form nests. e. Groups of interstitial cells, derived from Wolffian body; the so-called medullary cords. f. f. Blood vessels. g. Large nest.

the ovarian stroma, at innumerable points, as solid columns of cells out of which a certain number become converted into Graafian follicles. These sequestered columns or pegs of epithelial cells, known as Pflueger's tubes, have apparently no function other than the formation of Graafian follicles, which process is about complete at birth. They then remain sequestered in the tissues as embryonal rests, or undergo degeneration and absorption. (Fig. 206). Coincident with this growth of germinal epithelium into the

cortex, a similar process takes place from the adjacent Wolffian body into the medulla of the ovary. Innumerable small epithelial strands reach the hylus of the ovary from the Wolffian body, where they anastomose and then grow into the ovarian medulla as sexual cords. They may penetrate the medulla as far as the cortex, and come in contact with Pflueger's tubes before mentioned. It is easy to be seen that there are four epithelial structures within the ovary which are capable of producing cysts. One of these are Pflueger's tubes, taking origin from the germinal epithelial. Another is the medullary tubes, coming from the Wolffian body. The third is the Graafian follicles, which instead of rupturing, may continue to increase in size, producing cysts as large as walnuts or even much larger. The fourth is the epithelial cells of the corpus luteum, which instead of undergoing degeneration may proliferate and their growth result in the formation of a cyst.

CYSTS OF GRAAFIAN FOLLICLES.

As has been already stated, Graafian follicles instead of approaching the surface and rupturing may take on cystic growth and form single or multiple tumors upon the convex surface of the ovary. They produce small soft, somewhat pointed, thin-walled growths beneath the peritoneum, which are easily ruptured in handling. In size they may not be larger than a pea or cherry, but when many are in juxtaposition they may produce a tumor the size of an orange or even larger. They contain a thin, serous fluid or one mixed with blood and epithelial cells. In many of these cases the patients present symptoms ordinarily ascribed to a chronic ovaritis, from which they are really suffering. They have more or less continuous pain in the region of the ovary implicated, which is increased upon standing, and attended with soreness upon pressure in the corresponding iliac region, and often also a premenstrual pain lasting for several days. Upon bimanual examination the ovary can ordinarily be readily palpated and is recognized as being much enlarged, soft, semifluctuant and tender upon pressure. In some cases, however, where the cysts are small or few in number, there may be no marked symptoms.

TREATMENT.—In cases where the symptoms are pronounced the abdomen may be opened and the cysts enucleated, or the cyst bearing area excised by V-shaped incisions. The incisions in the ovary are then closed by a continuous catgut suture. The method practised by some is to puncture the cysts either with a scalpel or with the point of a Paquelin cautery.

CYSTS OF THE CORPUS LUTEUM.

After the rupture of a Graafian follicle the sac, in consequence of the hemorrhage, becomes filled with blood, while the cells lining the same proliferate vigorously, and then in the natural course of events are absorbed and their place taken by connective tissue. In some cases, however, the process continues active, the cells lining the sac proliferate, the rent closes and a cyst forms, which may be filled with a comparatively [illegible] fluid [illegible] tinged with blood. These cysts are lined with several layers of polyhedral cells, and may reach the size of a walnut or even an orange. In these cases the ovaries become enlarged, more or less fluctuant and sensitive, and the

patient is liable to have pain in the cyst. If the condition produces serious disturbance the cyst may, after exposure, be enucleated and the rent closed by catgut suture.

OVARIAN TUMORS PROPER.
CYSTO-ADENOMATA.

The ovarian tumor may have a single cavity, unilocular, or it may have many cavities, multilocular. This condition is apparently due to one of two causes. A compound cyst may be converted into a single cyst in consequence of the destruction of the partitions by pressure and absorption. A single cyst may be converted into many cysts, in consequence of the active proliferation of the epithelial cells lining the cavity, by means of which epithelial buds are formed upon its interior. These buds are later, as the re-

Fig. 207.—Mrs. M., age sixty-eight. Operated September 15, 1900, at St. Joseph's Hospital. Recovery. Weight of patient before operation 208 pounds. Weight of patient after operation 83 pounds. Weight of tumor 125 pounds. Abdominal girt, 58 inches, from ensiform to pubis 40 inches.

sult of a partial absorption, converted into cysts. The ovarian cyst proper has its origin either from the remnants of Pflueger's tubes, or from the remnants of the tubes coming from the Wolffian body.

A typical ovarian cyst has a beautiful, pearly, grayish-white, glistening appearance, the wall is made up of a fibrous stroma of greater or less thickness, being at times as thin as tissue paper and again thicker than binder's board. The wall may also be the seat of cartilaginous or osseous plates. Cysts are lined by cuboidal or low columnar epithelium. The cyst contents is a thin, clear, pale, straw-colored serum, having a specific gravity of about 1.025, or it may present a light, muddy appearance or be of a

dark chocolate color. The contents of these cysts instead of being serous or watery, may have a mucilaginous or jelly-like consistency. The fluid contains fat droplets, desquamated epithelium, blood, pseudo-mucin, and detritus. Ovarian tumors are situated primarily within the ovary and are attached to the broad ligament by the mesovarian and to the uterus by the broad and utero-ovarian ligaments. In the cyst's growth these structures are drawn upon, producing with the ovarian vessels what is known as the pedicle. These cysts implicate both ovaries in about six per cent. of the cases (Fig. 207).

SYMPTOMS AND DIAGNOSIS.—Ovarian tumors occur most frequently in middle life, being comparatively infrequent at the two extremes. While of slow growth they increase more rapidly in size than does the parovarian cyst, and much more rapidly than does the uterine myoma. Ordinarily however, it takes some years to produce a tumor of large dimensions. Being primarily situated to the right or left of the uterus, they push this organ to the opposite side, and partially fill the pelvis. Later they may become impacted in the pelvis, causing serious pressure upon the bladder with retention of urine, or more or less obstruction of the bowels, or pressure upon the nerve trunks, with resulting severe pain. Rising in part out of the pelvis, they are likely to drag the uterus to some extent to the side upon which they are situated, or getting behind the uterus, to press it against or above the symphysis, or if in front of the uterus, to crowd it into the hollow of the sacrum. Passing into the abdomen, if the growth is a single cyst, it will present a round, hard, tense, fluctuant surface, be dull upon percussion, movable, often free from pain, and situated to some extent upon the side from which it has taken its origin. As these cysts reach the position of the navel, the intestines float upwards to the epigastrium and laterally to the flanks, the central portion of the abdomen being occupied by the growth. If they reach great size they are likely to produce serious pressure upon the stomach, interfering with digestion and causing emaciation. They may press the diaphragm upward, thus compressing the lungs and interfering with respiration, and later with the heart's action. They may cause œdema of the lower limbs, shortness of breath, albuminuria, abdominal pain, and pronounced general weakness.

These growths must be differentiated from the myomata, which are directly connected with the uterus, much harder, do not present fluctuation and cause menstrual disturbances. They should be differentiated from growths of the kidney which usually lie behind the colon, and present a tympanitic note. Difficulty in a diagnostic sense may occur in cases of ascites. In marked ascites when associated with a tumor, the fluid seeks the flanks, forcing the intestines beneath the ribs and into the epigastrium while the center of the abdomen is occupied by the tumor. If there is only ascites, the umbilical region will be tympanitic, and the dull area will depend upon the position of the patient. In ascites (and this is most important) we can not feel a dense, resisting sac.

PROGNOSIS.—The prognosis of ovarian tumors may be said to be bad as they all tend toward death if not subjected to surgical interference.

COMPLICATIONS.—Ovarian cysts may form adhesions to the abdominal wall and adjacent viscera as the result of local peritonitis and pressure

Infection of the sac may occur from the adjacent bowel, and cause the formation of pus followed by fever, chills and high temperature. Twisting of the pedicle may take place, followed by excruciating pain, with more or less shock, collapse and the symptoms of localized or general peritonitis. In severe cases of torsion of the pedicle the circulation may be entirely interrupted and the growth become gangrenous.

Rupture of the cyst occasionally occurs as the result of injury or violent muscular exertion in cases where the cyst wall is extremely fragile.

Fig. 208.—Multilocular ovarian cyst removed from young married woman aged eighteen. Had noticed growth, which at time of operation filled pelvis and lower abdomen, for one year.

If the contents of the cyst are aseptic, which is usually the case, there may be a sudden and severe pain with rapid disappearance of the hard cyst wall, followed for one or two days by excessive polyuria. In a few days the rupture is closed by adhesions and the sac gradually refills.

TREATMENT.—There is no treatment of an ovarian tumor worth considering except that of removal, and in general terms it may be said that an

ovarian tumor should be removed as soon as it is causing by its presence any disturbance in the functions of the abdominal organs.

Technic.—A small incision is made in the linea alba, the sac seized with bullet forceps, the contents withdrawn, and the sac drawn out of the wound, its pedicle ligated and the sac removed. The wound is then closed as in any other laparotomy (Fig. 208).

CYSTS OF CONGENITAL ORIGIN—DERMOIDS.

Dermoids are innocent, slowly growing cystic tumors which take their origin from embryonal inclusions of either the epiblast or the hypoblast. The cyst wall is made up externally of connective tissue and has a lining of stratified epithelium supported by papillæ, corium, subcutaneous tissue and fat. Within this structure are to be found sebaceous glands, sweat glands, and hair bulbs, in fact all of the structures which are normally found within the skin. The cyst wall is often quite thick and resistant and may contain a considerable quantity of calcareous matter. If the dermoid is due to inclusions of portions of the hypoblast, the cyst wall will correspond in structure to a mucous membrane and its contents may include teeth.

Dermoid tumors may be unilocular or multilocular. Multilocular growths are often bossed, the surface being irregular and presenting only a semifluctuant sensation. If unilocular they are smooth, usually hard and quite tense, and may also present a semifluctuant feel. They often present a doughy feel upon pressure or palpation.

These tumors are quite variable in size, depending largely upon their location and immediate cause. Some are not larger than a pea or hazelnut, while others attain the size of an adult head. The contents of these cysts at the temperature of the body is usually fluid, but if the sac be removed and the temperature allowed to fall, the contents often become semisolid and even solid in consequence of the large amount of fatty material which the sac contains. Upon the interior of the cyst wall may be found sacs coming either from the sebaceous or the sudoriparous glands. The semifluid contents is made up largely of sebaceous material containing quantities of epithelial cells, cholesterin, fatty material, hairs and detritus. A higher type of glandular structure than the sebaceous or sweat glands occasionally occurs in the ovarian dermoids in the form of mammæ, with or without nipples. The nipples often contain ducts and the mammæ glandular tissue.

Histogenesis.—It is pretty generally held that the dermoid is due to some disturbance of embryonic development, in consequence of which some portion of the skin or mucous membrane, or a nest of embryonal cells, becomes included within the mesoblast. This inclusion occurs with especial frequency along one of the natural fissures of the embryo.

Dermoids may be divided into four genera, implantation, sequestration, tubulo and ovarian dermoids.

IMPLANTATION DERMOIDS.

These tumors do not correspond to the definition given of a dermoid, in that they are not congenital growths, but are the result of a traumatism in consequence of which some portion of the skin is detached and carried

into the subcutaneous tissue, where it retains its vitality, takes on grow and produces a cyst. These cysts usually occur upon such portions of tl body as are most frequently the site of traumatism, such as the palm surfaces of the fingers and hands. The persons who most frequently suff from this condition are needle-women, carpenters, shoemakers and butcher

These growths are round, somewhat elastic, and soft; they are situate in the subcutaneous tissue and consequently have no connection with tl skin. They are seldom larger than a hazelnut. It may perhaps be nece sary to differentiate them from ganglia, which are in direct connectic with tendon sheaths and are affected in their position and made more ten by the contraction of the corresponding muscle. The ganglia are al more tense on palpation and show greater elasticity and sense of fluctu tion than do the small implantation cysts.

SEQUESTRATION DERMOIDS.

In embryonic development the lateral halves of the body coalesce alo a median line which extends from the base of the skull down the ba through the perineum and genital organs up the abdomen, thorax a neck to the chin. Along any portion of this line of coalescence the cellul elements making up the skin may become sequestered into the deeper t sue and take on growth, producing a dermoid congenital in origin. It quite true that many of these growths at the time of birth may not be ta gible or apparent, but the tissues from which they subsequently grow we implanted or sequestered during embryonic development. Dermoids alo this line are of less frequent occurrence upon the posterior aspect of t body, barring the region of the sacrum and coccyx, than they are up or within the anterior region. Above the region of the sacrum they seldc reach any considerable size. When occurring along the region of the spi these growths, in consequence of their cystic character, their congeni origin and their situation in the median line are likely to be mistaken f cases of spina-bifida, with which they may even be associated.

DERMOIDS IN THE SACRO-COCCYGEAL REGION.

Dermoids occur much more frequently here and are much larger th upon any other portion of the back.

DERMOIDS OF THE ABDOMEN.

Dermoids have not infrequently been observed within the abdomi cavity, exclusive of the ovary. They have been found upon the peri neum, within the mesentery or omentum, and associated with the spleen kidneys. In these situations they may be explained on the theory that th have been inclusions of skin or inclusions of embryonal dermal cells.

DERMOIDS OF THE THORAX.

These may occur as small, well circumscribed, movable cysts, situat beneath the skin and over the sternum. They seldom reach any considera size and are comparatively rare. Dermoids may be situated within t thorax, behind the sternum, and in the anterior mediastinum.

Growths situated in the median line, disconnected with the skin, of congenital origin, or occurring soon after birth, and having a pseudo-fluctuant or doughy feel, may reasonably be suspected of being dermoids. If causing disturbance they should be enucleated.

DERMOIDS OF THE FACE AND NECK.

In the development of the face during embryonic life the large cavity which represents the mouth has connected with it five fissures. In the closure of these fissures, a portion of the skin occasionally becomes implanted or sequestered in the subcutaneous tissue, where it takes on active growth, and produces a dermoid cyst or cysts. These cysts may be situated at the root of the nose, at the inner or outer angle of the eye, along the center line of the cheeks or at the median line of the lower lip. In these

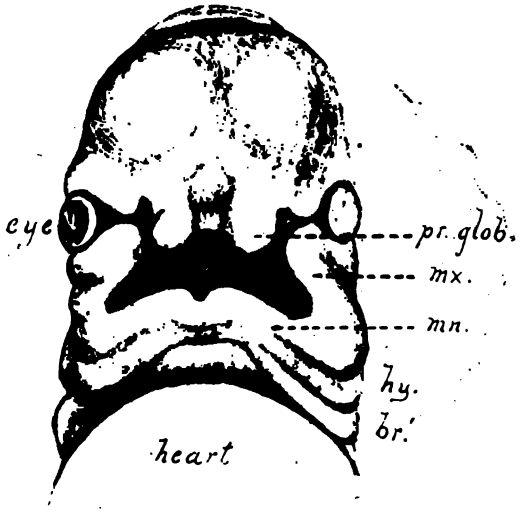


Fig. 209.—Head of embryo. (After His.) pr. glob. Globular extremity of the mesial nasal process. mx. Maxillary process. mn. Mandibular arch. hy. Hyoidean arch. br'. First branchial arch.

situations they present the characteristics of ordinary subcutaneous dermoid growths, being of congenital origin, but occasionally of post-natal appearance. They are painless, subcutaneous, globular, fluctulant, slightly movable tumors of slow growth, which seldom reach any considerable size. If causing disfigurement or producing serious pressure upon adjacent structures, they may be enucleated (Figs. 200).

BRANCHIAL CLEFTS.

In the formation of the pharynx there occur five arches and four clefts, known as branchial arches and branchial clefts. The first arch is the mandibular, which produces the lower jaw. The second is the hyoid, from which the hyoid bone is formed. The third is the thyro-hyoid, which is known as the first branchial arch, and below this there are two others

known as the second and third branchial arches. Between the five arc there are four cephalic, visceral or branchial clefts. In any of these br chial clefts portions of the epiblast may become sequestered and lie dorm for a time in the subcutaneous tissue, and then take on active growth a produce a dermoid cyst. Branchial dermoids of the neck are not of f quent occurrence. They are situated ordinarily upon the side of the n above or below the hyoid bone, and usually beneath the deep cervi

Fig. 210.—Congenital branchial tumor.

fascia. They present ordinarily the characteristics of deep-seated cy and in this situation occasionally reach considerable size. They are i infrequently in close relationship with the deep cervical vessels.

These growths, if causing unsightliness or reaching any considera size, may be exposed by incision and then enucleated, care being taken avoid injury of important structures situated deeply within the tissues the neck with which they may be intimately associated (Figs. 210, 211, 21

TUBULO-DERMOIDS.

The dermoids of this genus take their origin from the thyro-glossal duct. In the embryo this duct extends from each lateral lobe of the thyroid gland up the anterior portion of the neck to the dorsum of the tongue, where it terminates. The mouth of the duct is to be found in the median line, a short distance anterior to the posterior border of the tongue. (Fig. 213.) With the development of the hyoid bone, the duct at this point often becomes obliterated, leaving a lingual portion above and a thyroid portion below. In the ordinary course of events coincident with the development of the fœtus, the duct loses its lumen and disappears by degeneration and absorption. The upper portion within the tongue remains for a considerable period as a short, small opening or canal, known as the foramen cæcum. This opening may be of sufficient size to admit a small probe. It occa-

Fig. 211.—Congenital branchial tumor.

[illegible] happens that the duct, even from the dorsum of the tongue to the [illegible] of the thyroid, remains open as a patulous canal. If this is [illegible] the portions of the epithelium making up the tube do not [illegible] by degeneration and absorption, then the tube or epithelial cells [illegible] of the formation of dermoids. These dermoids may be sit- [illegible] three positions, in the tongue, near the hyoid bone, or over [illegible] These growths are frequently mistaken for sebaceous [illegible] of their being lined by stratified epithelium and filled [illegible] They usually are of congenital origin, although [illegible] being first observed perhaps during childhood or at adult

[illegible] painfully or causing pressure symptoms, the growth [illegible] and then enucleated.

DERMOIDS OF THE OVARY.

The ovarian dermoid is of much less frequent occurrence than the ovarian cyst, the proportion being about one to fourteen. They are most often met with at or about puberty, although they may occur in childhood or in old age. These growths while most frequently unilocular may be multilocular. In multilocular growths but a single cyst may show the char-

Fig. 212.—Branchial tumor.

acteristic lining and possess a contents which would indicate its dermoid nature. The cyst wall in some cases is thin, friable and almost translucent, while in others it is thick, tough and resistant. The cyst wall that presents itself to the abdomen has a peritoneal covering, and the grayish-white appearance of the ordinary ovarian tumor. Within this is a fibrous layer, and

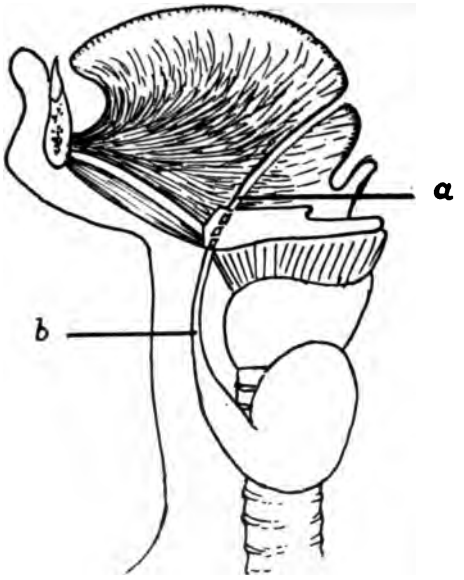


Fig. 213.—Thyro-glossal duct. a. Lingual portion. b. Thyroid portion.

then comes the lining peculiar to dermoids, namely, that corresponding to the skin or to a mucous membrane. (Fig. 214.)

DIAGNOSIS.—This ordinarily will be difficult insofar as differentiating the ovarian dermoids from ordinary ovarian cysts. The following conditions are, however, somewhat characteristic: They are most frequently unilocular, situated at one side of the uterus, often occur in young women, are

Fig. 214.—Multilocular ovarian dermoid.

not so distinctly fluctuant or of so rapid a growth as the ordinary ovarian cysts, but more likely to cause attacks of localized peritonitis. They often float, according to Kastner, in front of the uterus, and lie directly beneath the abdominal wall. In consequence of their frequent connection by adhesions to adjacent viscera, they are less movable than the ordinary ovarian cyst.

The treatment should be early removal.

TERATOMATA.

A teratoma may be defined as a tumor coming from two or possibly three of the germ layers and always including mesoblastic tissue. Some writers hold that the teratomata are the result of some stimulation applied

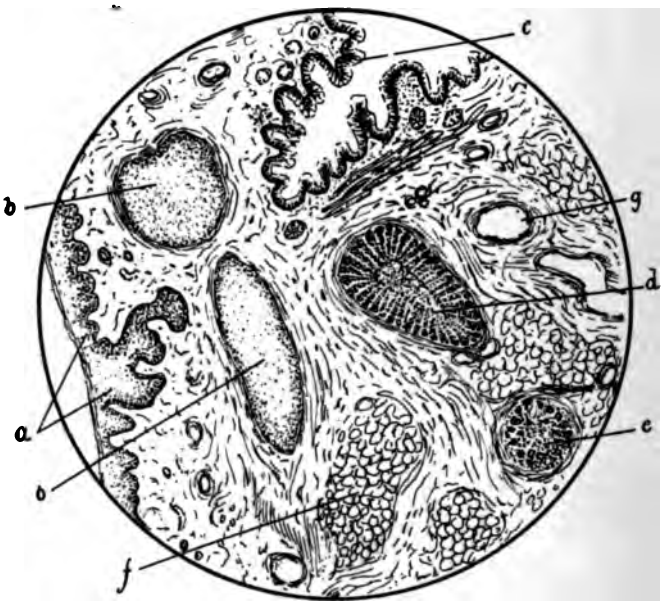


Fig. 215.—a. Epidermal growth. b. Cartilage. c Intestinal mucous membrane. d. Adrenal body. e. Kidney. f. Fat. g. Blood vessel.

to the ovary in consequence of which it attempts reproduction in a vicarious manner and without fecundation. Wilms, who has studied this subject carefully, holds that these tumors are the result of an atypical outgrowth of the three layers of the embryo.

Insofar as surgery is concerned the subject of the teratomata is only of interest when well-defined tumors are formed. A teratoma growing as a distinct tumor which may be amenable to surgical interference is found most frequently connected with the glands of generation, and especially with the ovaries. Here they may form tumors which cannot, perhaps, macroscopically, be differentiated from dermoids.

Teratomata, aside from the ovary and testicle, occur in the thorax in the sacro-coccygeal region, neck, orbit, and in the abdominal cavity. A teratoma of the peritoneal cavity might be the result of the transmigration

of an ovum. A very large congenital teratoma situated in the sacral region is not often amenable to surgical interference, both in consequence of its size and the feeble condition of the child. When these tumors occur elsewhere and in adults they will be subject to the same surgical rules and require the same technique in their removal as pertains to the removal of other benign growths in the same locality. (Fig. 215.)

CYSTS OF PARASITIC ORIGIN.

There are two genera of cysts due to the growth of parasites. One of these is the cysticercus and the other the echinococcus or hydatid cyst. The cysticercus is comparatively rare, and is the larval form of the tænia solium, or tapeworm. This tænia is frequently found in the intestinal canal of man. We are only interested in this connection in the production and

Fig 216.—a. Cysticercus. b. Circle of hooklets of Scolex in Cysticercus.

development of the parasitic cyst or cysts from the larval form to such a degree as to require surgical interference. It has been already stated that man may harbor both the mature worm and the larval form, the latter being the second stage of developmnt of the tænia, and usually requiring a second host for its production. This second host is usually the pig. In man it is thought that when he harbors a full grown worm, the segments when they are cast off may in consequence of their inherent power of motion propel themselves through the duodenum and reach the stomach in consequence of severe and protracted efforts at vomiting, or the ova may after having been discharged with the fecal matter contaminate the food or water taken and thus gain an entrance to the stomach, where the embryos are set free, and being provided with hooklets and power to penetrate the wall of the

stomach, they gain an entrance into the blood current or adjacent tissues or organs, where they produce a parasitic cyst. (Fig. 216.)

FREQUENCY AND SITUATION.—The cysticercus is said to be comparatively frequent in North Germany, being found once in every seventy-six bodies examined. In the United States it is extremely rare. Certain tissues seem to have a predilection for the parasite. Among these may be mentioned the brain, eye, subcutaneous tissue and heart.

Subcutaneously they occur as small, round, more or less painful, nodular growths, varying in size from that of a pea to that of a walnut. They are in this situation quite movable, and without special symptoms.

When situated in the heart they may produce symptoms of irregularity, functional disturbance, and perhaps valvular insufficiency.

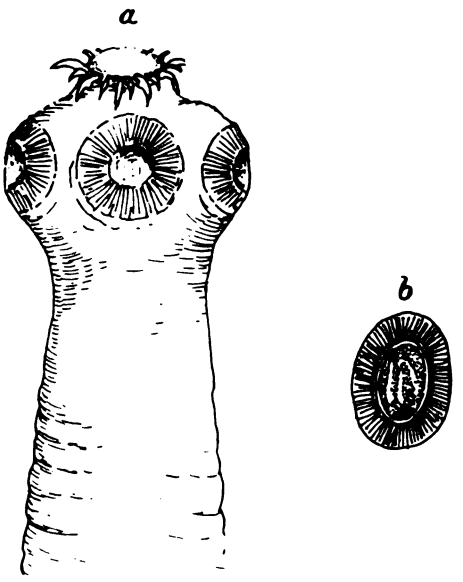


Fig. 217.—a. Head of Tænia Solium. b. Ovum of Tænia Solium.

Von Graefe was the first to demonstrate their presence in the eye. They are found here either in the aqueous or vitreous humors. They may be seen as clear vesicles possessing inherent motion in consequence of which they may readily be diagnosticated.

They are occasionally found within the brain, and also in the spinal cord. In the brain they may be situated within the membranes, in the ventricles upon the surface or within the cortex or ganglia. The tænia cysts have also occurred in the lungs, producing symptoms not unlike those of asthma, and in the lymphatic glands and in the bones.

TREATMENT.—When these cysts occur subcutaneously they may readily be excised. Occurring within the skull they will produce the symptoms of brain tumor and may, when exposed, be enucleated.

HYDATID CYSTS.

Hydatid cysts are the larval forms of the tænia echinococcus, the latter being frequently found in the intestinal canal of the dog. The mature tænia echinococcus is a white, thread-like worm, not more than four or five millimeters in length. It is difficult of detection in the intestinal canal of the dog, on account of its small size. The mature worm is composed ordinarily of four segments, the anterior one, or head, being possessed of four sucking disks and a rostellum carrying two rows of hooklets. (Fig. 217.) The head or first segment, as well as the second and third segment, is extremely small, while the fourth is the only one which is mature, and this one measures one-half as much as the entire worm. The fourth segment contains the ova, which ordinarily number about 5,000. This segment with

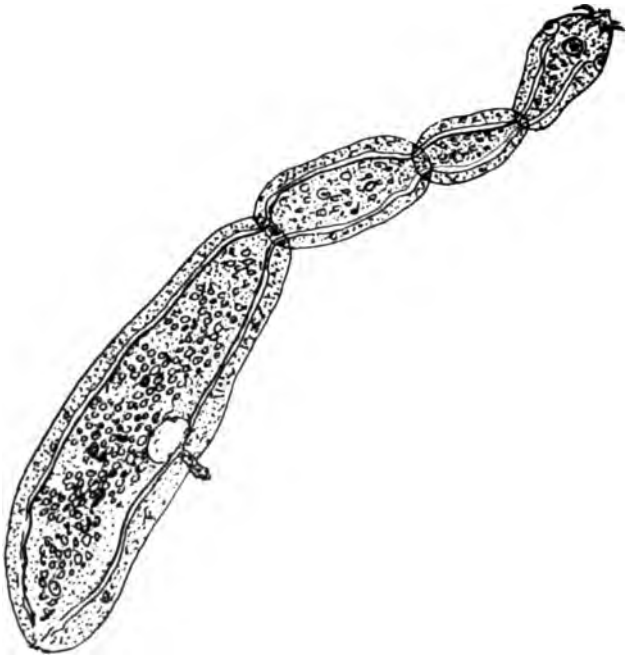


Fig. 218.—Tænia Echinococcus, sexually mature, showing water vascular system.

its ova, gains an entrance to the stomach of man with food or water, where the shell is digested, setting free the eggs. The eggshell is also disintegrated by the juices of the stomach or the intestines, setting free the embryo which is extremely small and contains, on its anterior extremity, six hooklets in pairs. These embryos make their way through the wall of the stomach or intestines to the peritoneal cavity, or they may enter the venous radicles of the portal system, or the adjacent lymphatics, and be carried to the liver. They may gain an entrance to the tributaries of the inferior vena cava, and be carried to the right side of the heart, and from there they are sent to the lungs, and being protoplasmic bodies they may pass the capillary system of the lungs and gain the left side [illegible] heart, and from there reach

any of the tissues or organs of the body. They are, however, much more frequently carried to the liver than to any other organ, not that they find this tissue a more favorable habitat in which to grow, but because they gain an entrance to the radicles or lymphatics of the portal system, and thus more frequently are found in the liver. Once finding a resting place the embryo loses its hooklets and is converted into a cyst. (Fig. 218.)

The statement has been made that hydatids are to be found over as wide an extent of country as is the domestic dog. They are found, however, much more frequently in some countries than in others. They seem to be specially frequent in Iceland, in which country they are the cause of a very considerable mortality. Next to Iceland they are said to be more frequent in Silesia and then in Australia. In the latter country they are of very fre-

Fig. 219.—a. Cuticula of Echinococcus Cyst. b. Hooklets from Scolex, highly magnified.

quent occurrence. In North America they are comparatively rare. (Fig. 219.)

When occurring in the liver they produce a slowly growing, painless tumor within the substance of the organ, or a growth which projects from some one of its surfaces. Hydatids of the liver may reach such a size as to fill much of the abdominal cavity and produce pressure upon the lungs, stomach, intestines or heart. Ordinarily the cyst is characterized by its slow, painless, non-sensitive growth—a growth which may consume years in reaching large dimensions; a growth which does not interfere under ordinary conditions with the health or well-being of the individual, and which produces no loss of flesh or strength. The cyst if near the surface may show indications of fluctuation, or the hydatid fremitus may be demonstrated. This is determined by placing the left hand upon the surface of

the swelling, when one of the fingers is struck sharply by a finger of the right hand. If the fremitus is present a distinct thrill or vibration is imparted to the hand struck. If infection occurs in a hydatid cyst of the liver the symptoms will change to those of an hepatic abscess.

In making a diagnosis of hydatid cyst of the liver, the surroundings and the habits of the patient should be taken into consideration. (Fig. 220.)

ECHINOCOCCUS CYSTS IN BONE.

The multilocular form is the one which most frequently occurs in bone. Hydatids in bone lead to more or less pain, absorption of bone structure and, it may be, fracture. They present the symptoms of a cystic tumor of bone, and have a very slow, indolent growth, often running on for years. The individual cysts vary in size from that of a millet seed to that of a

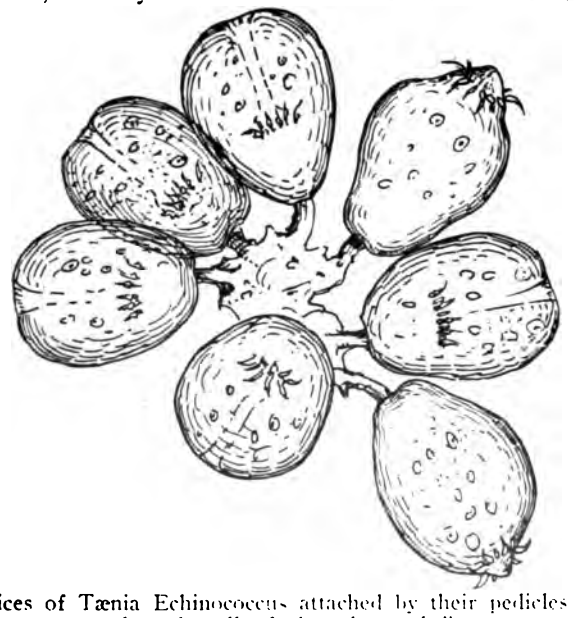


Fig. 220.—Scolices of Tænia Echinococcus attached by their pedicles to part of collapsed wall of "brood-capsule."

hen's egg. They may break through the bone and invade surrounding parts. They occur more frequently in the long bones than in the flat.

HYDATIDS IN THE HEART.

Hydatid cysts occasionally occur in the heart, either in the muscular structure or in the auricles or ventricles. When occurring in the cavities of the heart they usually are the result of the embryos being brought there in an embolus. In these situations they usually cause irregularity of the heart's action and often lead to the death of the patient.

HYDATIDS IN THE KIDNEY.

A large number of cases have been reported. The cyst is usually situated in the substance of the kidney, often projecting into the pelvis. It

produces an innocent, very slowly-growing tumor, which is covered in fr by the colon and consequently is tympanitic and moves freely with d inspiration. If of considerable size there may be fluctuation. The cyst infrequently ruptures into the pelvis of the kidney, and its contents is tl discharged with the urine.

HYDATIDS OF THE THYROID GLAND.

Hydatids in this situation are extremely rare. When occurring tl produce painless, somewhat fluctuant, slowly-growing tumors.

HYDATIDS OF THE MAMMARY GLAND.

More than twenty cases of hydatid cysts in the mammary gland h thus far been reported. Most of these have occurred in adult women. T make their appearance as painless, slowly-growing, perhaps slightly fl tuant swellings, which are ordinarily well circumscribed and which grow slowly that they require from ten to fourteen years to reach any con erable size.

HYDATIDS OF THE LUNG.

Hydatids of the lung are rare and difficult of diagnosis. The condit occasionally presents the symptoms of tuberculosis, and then again of pl risy, or of a tumor of the lung. Occasionally there are few or almost symptoms, but as a rule there is a severe, dry, distressing cough, pain in breast, some dyspnœa, and often a bloody expectoration. There is usu a well-circumscribed area of dullness, depending for its size upon the mensions of the cyst and its nearness to the pleural surface. The gen health, as a rule, is not seriously interfered with. There is no fever, loss flesh or debility. Not infrequently the parasitic condition has been un pectedly discovered at the autopsy, or during an operation carried out the purpose of draining the pleural cavity, or an abscess of the lung, or cyst has opened through a bronchus and its contents discharged thro the mouth, making the diagnosis easy. Should infection occur the sympt of pus formation, such as chills, fever, pain, with perhaps œdema of chest wall will occur.

The echinococcus cyst has also been found in the brain and spinal c

Diagnosis and Differentiation.—*Hydatids of the Liver.*—The cl acteristics or differential symptoms of hydatids of the liver from o pathological processes may be summed up in a comparatively few wo They are especially to be differentiated from carcinoma, abscess, gumm and from an enlarged gall-bladder. Hydatids in this situation, as elsewh are characterized primarily, perhaps principally, by the fact that they benign cysts which do not necessarily, except by pressure, interfere the health or well-being of the patient. They are of extremely slow gro rquiring ten or even twenty years to reach any considerable size. Situ within the liver, those containing daughter cysts or fluid, are fluctu elastic, painless growths, which may present a hydatid fremitus upon cussion. The multilocular hydatid is also found in the liver; it produc well circumscribed tumor which is characterized by its extreme hardn and slow, painless growth. Malignant growths affect the health and

stitution, and destroy the patient's life; the gummata are circumscribed, indolent growths of small size, while the patient may present the symptoms and give a history of syphilis. An abscess is sensitive, painful, attended with chills and fever, often with œdema of the skin, and severe throbbing pain. The symptoms are progressive.

TREATMENT.—In hyatids of the liver, the operation of Volkmann has usually been followed. This is divided into two stages. The first stage consists in cutting down to the cyst wall, usually below the lower border of the ribs, then packing the incision with iodoform gauze until the liver has formed adhesions to the parietal peritoneum. This process usually requires two or three days. Then the second operation consists in freely incising the cyst, clearing out the contents and establishing drainage. In some cases the mother cyst can be enucleated.

Fig. 222.—Immense round-cell sarcoma of scapula in a girl aged 18.

MALIGNANT TUMORS.
SARCOMATA.

A sarcoma may be defined as a malignant tumor taking origin from connective tissue. The cells of a sarcoma are immature or not fully developed connective tissue cells.

The principal subdivisions according to the form of the cell are into round-, spindle- and giant-cell sarcomata. The round-cell form is still further divided into small and large round-cell sarcomata.

The small-cell round-cell sarcoma is made up of extremely small cells, which resemble in size the white blood corpuscles, or the cells of adenoid tissue. These growths have as a rule very little stroma or inter-cellular substance, the cells being placed almostly directly upon each other. The tumors

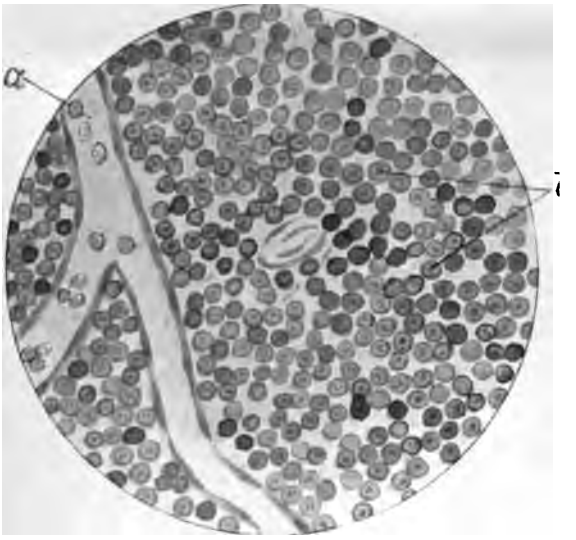


FIG. 221.

Small round-cell sarcoma.

a. Capillary lined by endothelial cells.
b. Round cells.

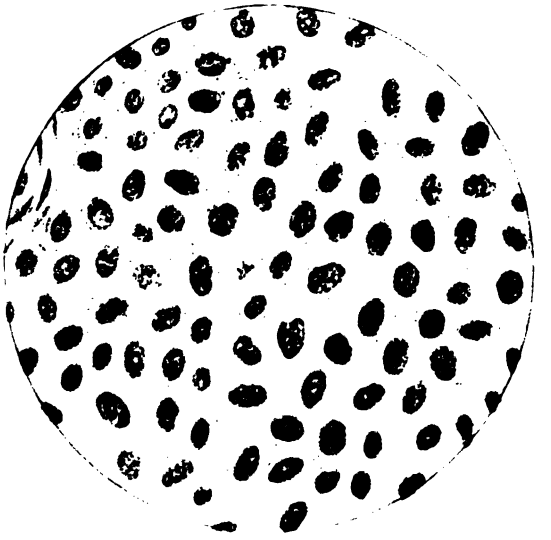


FIG. 223.

are soft, richly supplied with blood, grow with great rapidity, may reach a large size, are not encapsulated, and are among the most malignant of all the malignant growths. They grow from intermuscular, subcutaneous and submucous tissues, from lymphatic glands and nodes, from the kidney, testicle, and occasionally, but rarely, from the liver. They usually have a pretty uniform consistency, barring degeneration and the formation of cysts, and present on section a grayish-white, yellow, or a faint reddish appearance.

(Fig. 221) Small round cell sarcoma.

(Fig. 222) Round cell sarcoma of scapula in a girl 18.

THE LARGE-CELL ROUND-CELL SARCOMATA.

These tumors, like the small round-cell, are composed largely of cellular elements, having little stroma or intercellular substance. The cells are round or oval and contain one or more nuclei. They are often spoken of as epitheloid cells. Both the stroma and intercellular substance, however, vary in different tumors and may vary in different parts of the same tumor. They have a rich blood supply, are soft, grow rapidly and form large non-encapsulated tumors. They do not, however, grow as fast as the small round-cell and are not ordinarily as malignant in that they do not infiltrate or invade adjacent tissue as readily, or produce in a short time as large and varied metastases. These tumors take origin with especial frequency from intermuscular connective tissue, from nonstriated muscles, and from the uterus (Fig. 223).

THE SPINDLE-CELL SARCOMA.

This species is also divided into two subdivisions, the small and large spindle-cell sarcoma. The small-cell spindle-cell sarcoma is made up of very small, short, slender cells which are often arranged longitudinally with the blood vessels. There is usually but little intercellular substance, the cells being bound together in bundles by a delicate stroma of connective tissue. The tumors are quite hard, resembling closely in consistency an ordinary dense fibroid. They have only an indifferent blood supply and consequently grow slowly. They have usually—at least primarily and before degenerative processes have occurred—a uniform consistency and are the most benign of all malignant growths in that they are frequently distinctly encapsulated, do not invade, at least to any extent, adjacent tissues, but push them to one side, and only rarely and at a late period produce regional or metastatic infection. They seldom reach, unless after some years of growth, any great size. They take origin from fascia, the walls of blood vessels, from nerve-sheaths, the skin and subcutaneous and submucous tissue (Fig. 224).

The large-cell spindle-cell sarcoma is composed of large, spindle, or oatmeal-shaped cells, which have an oval-shaped nucleus and contain a large amount of protoplasm which may be finely granular or finely fibrillated. The stroma and intercellular substance varies greatly. They often form large, round, or bossed tumors, which may for years be of slow growth, and then in consequence of some intercurrent complication take on a rapid increase in size. They are primarily of uniform consistency, but like all

sarcomatous growths may be the site of cystic formations in consequence of degeneration or hemorrhage, one or both. They are of more rapid growth and also more malignant than the small spindle-cell sarcoma. They are frequently found growing from fascia, periosteum, subcutaneous connective tissue and from intermuscular tissue. They seldom take origin from the connective tissue of glands or organs. They are quite frequently encapsulated and may for many years manifest none of the characteristics of malignancy (Fig. 224).

THE GIANT-CELL SARCOMA.

The cells of this species are very large, usually irregular in form and flat. They contain many nuclei, occasionally as many as one hundred, the nuclei being arranged often around the circumference of the cells as in a giant-cell of tuberculosis. It is seldom in this species that the giant-cell

Fig. 224A. [illegible]

is found entirely alone, but it is usually in connection with either the spindle- or round-cell or with both, the giant-cell simply predominating. They form soft, non-encapsulated tumors, which take origin either from the periosteum or the medulla of bone. Being non-encapsulated they invade and destroy adjacent structures and produce regional infection and metastases. They usually grow slowly and perhaps are often found in connection with the lower jaw, but may be found taking origin from almost any bone in the skeleton, especially from the ends of the long bones, as the lower end of the femur or upper end of the tibia. They are more malignant than the spindle-cell, but less malignant than the round-cell sarcomata (Fig. 225).

In all sarcomatous growths there is a varying amount of intercellular substance. This may be homogeneous, granular, or finely fibrillated. In very rapidly growing tumors, as in many of the round-cell sarcomata, the intercellular substance is extremely limited, the cells seemingly being placed

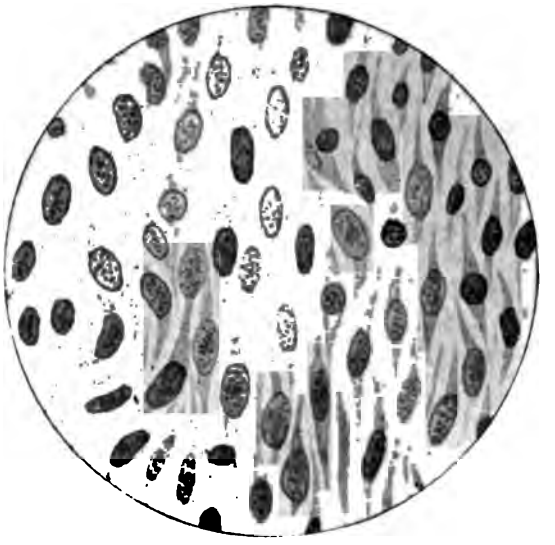


Fig. 224B.—Large spindle-cell sarcoma.

one upon the other, while in some of the more slowly growing tumors, and especially in some of the mixed growths, as in the myxo-sarcomata or chrondro-sarcomata, the intercellular substance makes up almost the major portion of the tumor. It must not be held, however, that tumors which contain a considerable amount of intercellular substance are necessarily only mildly malignant, because many of the myxo- and chondro-sarcomata show

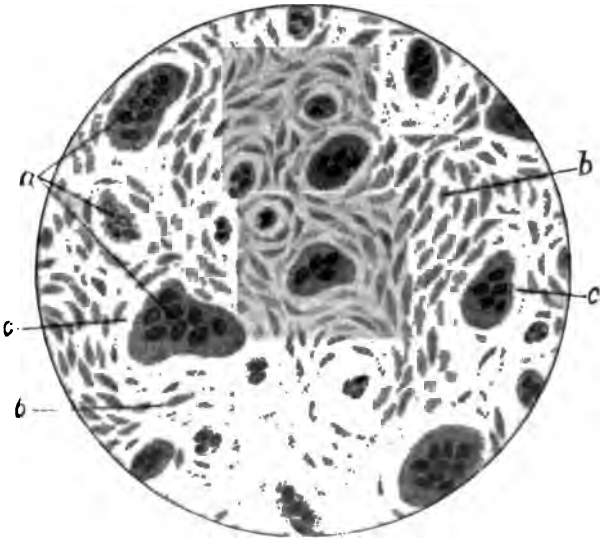


Fig. 225.—Giant-cell sarcoma. a Giant cells. b Small spindle-celled stroma. c. Peri cellular space

in their metastases and effects upon the system characteristics which indicate extreme malignancy (Fig. 226).

The stroma of a sarcomatous growth, while differing greatly in amount, forms as a rule but a very small portion of the tumor. It is composed of fibrous or connective tissue in which are more or less of spindle cells. The stroma makes up the capsule when one is present, from which numerous partitions are sent into the growth, giving its structure what little support it has. The stroma of a sarcoma is largely new-formed and does not keep pace in growth with the proliferation of the cellular elements. Consequently these growths, especially those which increase rapidly in size, have very little stroma.

In a benign growth the blood vessels on reaching the capsule break up into numerous branches and are supported by the trabecular processes which

Fig. 226.—Sarcoma of upper jaw which had extended down over tonsil to lower jaw. Non-operable.

are given off from the capsule. In this way they reach every portion of the growth. In a sarcoma there is ordinarily very little stroma, consequently few or almost no trabeculæ. The vessels then, instead of being supported by connective tissue stroma permeate the growth between the individual cells which are placed upon and proliferate directly around the vessels. The only support which the vessels receive is from the soft cells of the part. The vessels are generally new-formed and are then made up of a single layer of endothelial cells around which the sarcomatous structure is built. In many cases the blood courses through channels or canals hollowed out of the growths which have no distinct coat, but are lined simply by the cells of the tumor. In other instances the vessels may be in part at least preexistent, in which case they possess the three coats of a normal vessel. The fact that the vessels of a sarcoma are not supported by the stroma as in

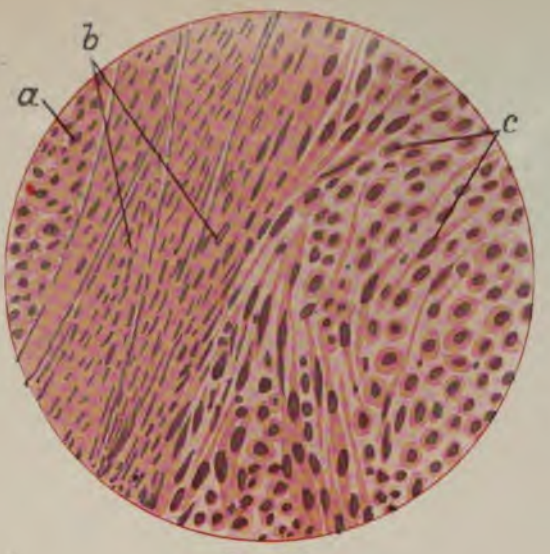


FIG. 227.

Muscular tissue of a myoma, going over into sarcomatous tissue, by process of metaplasia.

a. Muscle fibres cut across.
b. Muscle fibres cut diagonally and longitudinally.
c. Sarcoma cells.

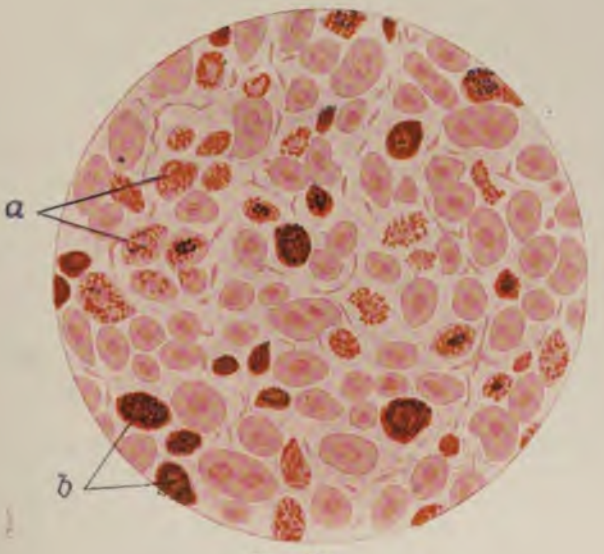


FIG. 228.

Melano-sarcoma.

a. Slightly pigmented cells.
b. Deeply pigmented cells.

other tumors, and the further fact that they usually have but a single coat, or often no coat at all, explains the great frequency in these growths of hemorrhages and cystic formations (Fig. 227).

It has already been stated that a sarcoma may take origin wherever connective tissue is to be found. According to Cohnheim's theory this tissue is always embryonal in character and occurs as rests of embryonal cells or as vestiges of congenital structures. Borst holds that sarcomatous growths are never produced out of mature connective tissue by the process of metaplasia, but that the immature embryonal cells which under ordinary conditions might form a fibroma are arrested in their development at a stage higher than embryonal tissue, but lower than fibrous or fatty or myxomatous tissue, and thus come to be sarcomatous in nature and form a sarcoma. He believes that the round-cell or spindle-cell or giant-cell sarcoma, had it not been arrested in its development, might have become any one of many benign tumors. It has, however, long been held by many pathologists and embryologists that the cells of a tumor belonging to a particular species might be converted into another species of the same or of a different genus by the process of metaplasia. A large number of cases have been reported in which this process seems to have occurred.

Multiple primary benign growths are of frequent occurrence; multiple primary malignant growths are among the pathological curiosities.

Consistency and Form.—The sarcomata although not encapsulated are, nevertheless sufficiently defined so as to produce a distinct tumor. They present usually a round, globular or somewhat irregular or bossed surface. In consistency they vary greatly. The round-cell, rapidly-growing sarcoma is extremely soft and almost semifluctuant, while the spindle-cell sarcoma has ordinarily the hardness of the fibroid or myoma. The chondro-sarcoma and the osteo-chondro-sarcoma, taking origin from bone or periosteum and made up of spindle or mixed cells in which there are areas of bone and cartilage, have almost the hardness and density of cartilage or bone. There is, however, one extremely characteristic point relating to the consistency or hardness of a sarcoma, and that is that they are almost never of uniform hardness. At various areas they are quite hard and perhaps somewhat irregular, and then soft and fluctuating cavities occur, which are scattered over the surface, and which vary greatly in size and shape. These cysts are the result of degeneration of the tumor substance and of hemorrhages into the cavities formed.

Round-cell sarcomata often have an extremely rapid or mushroom growth, attaining the size of an infant's head within two or three months. On the other hand, the spindle-cell inter-muscular sarcoma may require from two to three years to reach the size of an orange. The sarcomata as a rule, however, grow rapidly and produce large tumors in a short time.

MELANO-SARCOMATA.

The melano-sarcomata occur in tissues which are normally pigmented, as in the skin and the choroid of the eye. It is probably true that in these conditions the connective tissue primarily implicated gets its pigment from the adjacent epithelial cells, and thereafter is capable of reproducing this pigment as the cells proliferate. The cells of a melano-sarcoma are usually

spindle-shaped or like epitheloid cells. The stroma often separates or encloses the cells in alveoli. These tumors are usually soft, grow rapidly and are extremely malignant. In color the tissue is often as black as ink. This color, however, varies and may be brownish, or a portion of the growth may be quite colorless. Much of the tumor is in a fluid state and if a gland is broken in the process of enucleation, its black contents will often flow

Fig. 229. Melano-sarcoma of the chin.

over the adjacent tissues, staining them black (Figs. 228 and 229).

Sarcomatous growths may consist in part of fatty tissue, and then are known as lipo-sarcomata. If they are made up in considerable part of cartilage, they are known as chondro-sarcomata; and of bone as osteo-sarcomata. If fibrous tissue predominates they are known as fibro-sarcomata; if mucomatous tissue is present they are known as myxo-sarcomata, and if

the blood vessels are pronounced they are known as angio-sarcomata. Where the cells are enclosed in alveoli they are known as alveolar sarcomata.

DIAGNOSIS OF SARCOMATOUS GROWTHS.—There are certain conditions which should be taken into consideration in a diagnosis of sarcomatous growths. One of these is the age of the patient at which the growth makes its appearance. The sarcomata are of frequent occurrence in childhood and may even occur in infancy, but they are most frequent during young adult life. It is quite true that they may occur in old age, that is in senile tissues, but this is rare. One should remember that sarcomatous growths always take origin from some form of connective tissue, and that although this tissue is pretty widely distributed, this fact nevertheless aids one very materially in making a diagnosis, as well as in differentiating them from malignant growths which spring from epithelial structures.

Sarcomatous tumors being as a rule non-encapsulated have no distinct limiting border, and consequently infiltrate the adjacent structures. They do not, at least to any marked degree, produce regional infection through the lymphatics as do carcinomatous growths. In their growth and in consequence of their rapid cell proliferation, they infiltrate the connective spaces and extend along the adjacent anatomical planes. It is not, however, so very infrequent to find the lymphatic glands, situated in the course of the lymphatic current, enlarged and infiltrated with sarcomatous elements. This is notably the case in sarcomata of the tonsil and of the testicle.

Metastases in internal organs or in distant tissues very frequently occur in sarcomatous growths and usually through the blood vessels. A number of cells or groups of cells gaining an entrance into the venous return current are carried to the right side of the heart and from there sent to the lungs, where they meet the first set of capillary vessels. Experience teaches that they are often arrested in these capillaries and produce metastatic growths within the lungs. Should they pass the capillaries in this situation they reach the left heart, the general arterial current and the distant viscera and tissues of the body. They frequently, however, after the lungs find an abiding place in the liver, spleen, kidneys, brain, subcutaneous tissue or medulla of bone.

While the rate of growth varies seemingly with the different species, and again with the same species in different situations and in different individuals, it may be stated that the sarcomata have a much more rapid growth than do the benign tumors. They also produce tumors in the extremities, when taking origin from bone or periosteum, from intermuscular tissue, fascia or subcutaneous tissue, which reach a much greater size than is the case with benign growths taking origin in the same situations. A large tumor taking origin in an extremity or from the bone, and having reasonably rapid growth, is almost always a sarcoma. The same may be true, although not to quite the same extent, of large tumors in the mammary gland. The rapidly growing tumors of the kidney, testicle, tonsil and even of the uterus, those which attain in a short time a large size, are with few exceptions sarcomatous in their nature.

Subcutaneous, metastatic deposits occurring through the venous and arterial circulation, are of sufficiently frequent occurrence in sarcomatous

growths to merit separate consideration. They take, in these situations, the same general characteristics and form of cells and malignancy as the original growth. They are never encapsulated and often grow with decided rapidity. While these metastatic deposits are most frequently situated subcutaneously, they are often placed between muscles or fascia. In a sarcomatous growth of an extremity, the proximal portion of the limb should be carefully examined for metastases. They are usually sensitive, fixed to the adjacent tissues, and more or less irregular. Many of these secondary growths are occasionally found in the later stages of a sarcoma, and at a time when the system seems more or less saturated with the infectious material of the neoplasm.

The capsule is only to be found in spindle-cell sarcomata, and it may be in part new tissue resulting from the irritation of the rapidly proliferating tumor cells, but it is largely a condensation of the adjacent tissue which has been pushed one side, consolidated and converted into a capsule. It is generally held that the cells of malignant growths proliferate at their circumference, while those of a benign tumor grow from the center. Borst states that tumors which have a capsule, benign or malignant, grow from the center, while those which are not encapsulated grow from the periphery.

Sarcomatous growths following an injury seemingly is of such frequent occurrence as to be of diagnostic value. So often have sarcomatous growths been preceded by an injury in my own experience that I consider it one of the most frequent predisposing factors, and when in a young person an injury precedes a rapidly growing tumor, taking origin especially from periosteum or bone, this fact should be considered of pronounced significance.

Diagnosis.—In a diagnosis one should strive to determine first whether the growth is benign or malignant, and if malignant whether it is a sarcoma or a carcinoma. The situation, the want of uniform consistency, the rapidity of growth and want of a distinct capsule, the fixity, the metastatic and possible glandular complications, the interference often with the health and well-being of the individual, ulcerative processes, the pain and often precedent injury are usually sufficient to denote that the tumor is not benign. From a carcinoma the differentiation may be easy or most difficult, depending upon the characteristics of the individual growth. The hard, nodular, slowly-growing scirrhus presents none of the characteristics of the sarcoma. The same is true of the epithelioma. The encephaloid carcinoma, however, when occurring in glandular structures such as the breast, kidney, testicle, uterus, ovary or parotid gland, presents conditions which upon examination are extremely like those of a sarcoma, in that the tumor is very soft, grows rapidly, has no capsule, invades adjacent structures and is often of unequal consistency. Primarily it might be extremely difficult to differentiate these growths. There are, however, certain conditions which should be taken into consideration. A sarcoma occurs in childhood or young adult life, a carcinoma seldom before fifty. A sarcoma seldom implicates or produces enlargement of the proximal lymph glands; the carcinoma, however, always does, and at an early stage. It is stated by Borst, and is in the main true, that the sarcomata do not produce a cachexia, while it is a well-known fact that carcinomatous growths, especially when metastatic deposits have oc-

curred, or ulceration has taken place, or toxæmia is pronounc produce a cachexia to a most pronounced extent.

Sarcomatous growths in the joints are of quite frequent They take origin either in the end of a bone, from the synovial or in the capsule, and in their growth, especially at the knee, s a large mass of soft tissue, which fills the joint and extends to

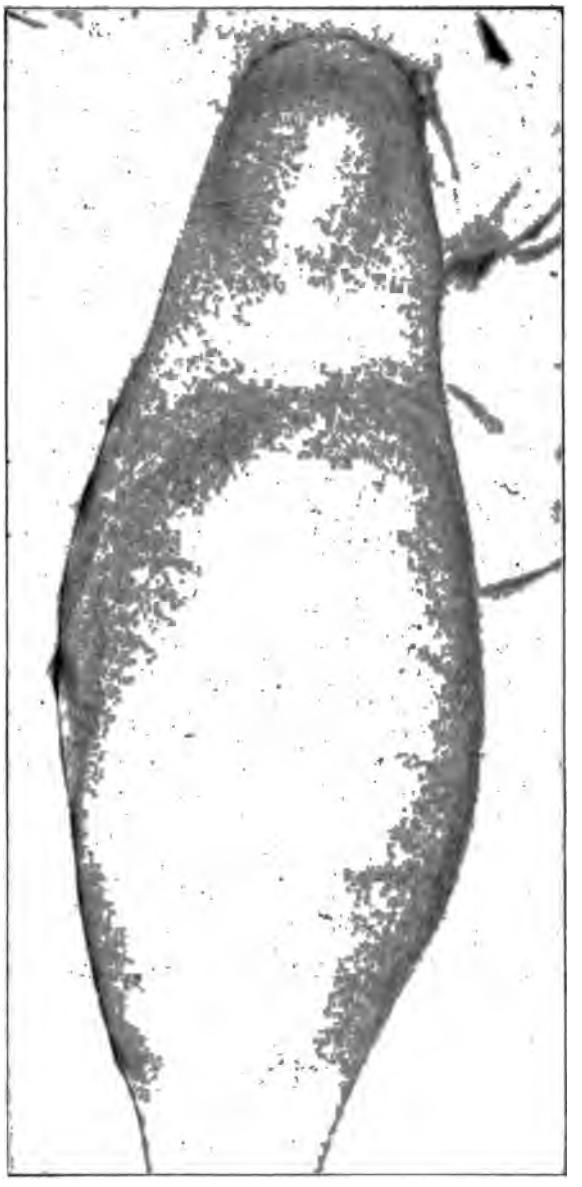


Fig. 230.—Osteo-chondro-sarcoma of tibia.

bone. The ends of the bone are eaten away and in one or two years a large, globular or spindle-shaped tumor is produced. By this time the patient's health is seriously interfered with. The condition is often mistaken for tuberculosis of the joint, but they have little in common. It is true that both processes are chronic, cause pain and disability, and occur in young persons. Tuberculosis, however, may produce a dropsy, but never a large, solid tumor. The joint, unless there is an accumulation of fluid, remains of about normal size, or is only slightly enlarged. There is frequently also a history of tuberculosis, and in sarcoma there is often a large tumor which increases the circumference of the joint perhaps two or three times beyond the normal. The surface also is not of a uniform consistency; areas of hardness intermingle with those which fluctuate.

It is of the utmost importance that one be able to make an early diagnosis of sarcoma taking origin from the medulla or periosteum of bone. It is a well recognized fact that a traumatism often precedes and often acts as an exciting cause of these growths. A sarcoma having origin from the medulla causes, almost from the beginning, a persistent, dull, heavy, aching pain in the part affected, and [illegible] epiphysis. This pain is often present for weeks and [illegible] months before marked swelling makes its appearance, and [illegible] pressure of the growth upon the bone, which it finally [illegible] destroys. The swelling is caused by the expansion of the bone [illegible] of the growth having permeated the osseous structure [illegible] the surrounding tissue. Following the destruction [illegible] a fracture may occur. Persistent, long-continued [illegible] swelling perhaps of the adjacent joints, enlargement [illegible] and, it may be, fracture—the condition occurring [illegible] or middle life—are among the most characteristic [illegible] medullary sarcomata. The sarcomata taking origin [illegible] produce pain and swelling, but the swelling is [illegible] pain. If the bone be deeply situated [illegible] the swelling may not be readily observed. [illegible]

In endeavoring [illegible] of bone in the early stages, when a diagnosis [illegible] with almost insurmountable difficulties. [illegible] differentiated from acute inflammation such as [illegible] and arthritis, in consequence of the [illegible] only be made of those conditions [illegible] are much more difficult to differentiate [illegible] rheumatism, to tuberculosis, [illegible] traumatism will afford a history [illegible] near in a short time under rest [illegible] of rheumatic origin may [illegible] want of swelling, the [illegible] application of dry heat [illegible] the diagnosis, [illegible] in the epiphysis [illegible] but frequently [illegible] of tuberculosis. [illegible] patient is usually

a child and the bone will present one or more small, well-circumscribed and sensitive areas. (Fig. 231.)

PROGNOSIS.—The prognosis of sarcomatous growths is always bad, in that they not only interfere with the health and well-being of the individual, but also sooner or later destroy the life of their host. The prognosis, however, while always unfavorable, varies with the situation and with the species. As has been already stated, the small-cell spindle-cell sarcoma runs an almost benign course, and seldom destroys life in less than five years, while the patient may survive ten or even twenty years. The same is true, though to perhaps a much less degree, of the giant-cell sarcoma, in which case the patient may live for many years, while the round-cell sar-

Fig. 231.—Spindle-cell sarcoma of thigh.

coma has as bad a prognosis as the most malignant carcinoma and often destroys life in a few months.

TREATMENT.—The treatment of sarcomatous growths is that of early removal, the method depending very largely upon the situation and the species. The giant-cell sarcoma is frequently only mildly malignant, and when affecting the interior of bone, conservative methods of treatment will often succeed. This conservatism may consist in the removal of these growths by knife, chisel and curette, by excision of bone, or by amputation. The round- and spindle-cell sarcomata taking origin from the periosteum, require in their treatment the removal of the bone from which they have originated. In other words, a patient having a round-cell sarcoma of the tibia should have the leg amputated well above the growth, or exarticu-

lation performed at the knee. One having a round- or mixed-cell sarcoma implicating the knee joint or shaft of the femur, should have the leg removed at the hip. The round- or mixed-cell sarcoma springing from one of the bones of the forearm, should be treated by high amputation or exarticulation at the elbow, and one taking origin from the humerus requires the same treatment at or near the shoulder-joint. It is quite true that the treatment often practised is less extreme in that the attempt is made to do an enucleation, partial resection of the bone, or an amputation through the bone implicated. The enucleation and partial resection seldom and perhaps never succeed in this class of cases, and an amputation through the continuity of the bone implicated is extremely likely to leave within the bone or adjacent tissues foci of infection which sooner or later will produce new-growths quite as malignant as the one for which the operation was instituted. It is far better to sacrifice a little more of the tissue or even a portion or all of the limb, and save the patient's life, than to temporize and have the operation a failure.

Growths which take origin from fascia, intermuscular or subcutaneous tissue, are composed of spindle-cells, distinctly encapsulated and quite freely movable, may be readily shelled out, and if recurring after one or two years again be removed, and this removal may occasionally be repeated again and again without the patient suffering materially therefrom. These growths, however, invariably recur after enucleation, and each return is more rapid in development and slightly more malignant than was the original tumor. For this reason it seems to be the part of conservatism and wisdom when these tumors occur in an extremity, to do an amputation well above the growth, or to exarticulate at the joint above.

SARCOMATA OF THE CLAVICLE.

Sarcomatous growths in this situation are of less frequent occurrence than are those implicating the tibia or femur. They do, however, occur and may reach a large size. They may be confined to either extremity, to the middle portion, or invade the entire clavicle. They extend in the direction of least resistance, which is upwards and outwards.

In their removal the entire clavicle usually has to be excised.

SARCOMATA OF THE SCAPULA.

Sarcomatous growths of this bone are of unfrequent occurrence. They may have their origin in any portion of the bone, or may be seated primarily upon its external or internal surface. They are, however, in the majority of instances, situated either in the superior, inferior or in the subscapular fossa. In any of these situations the growth soon penetrates the thin shell of bone and makes its appearance beneath the periosteum of the opposite surface. There is, under ordinary conditions, some difficulty in making an early diagnosis. A growth springing from the periosteum, beneath the supra- or infra-spinatus or the subscapularis muscle, is well protected from palpation, and is not easily detected, at least at an early period. The process is, however, attended by a severe grinding pain, with decided sensitiveness upon pressure, often with weakness or lameness in the corre-

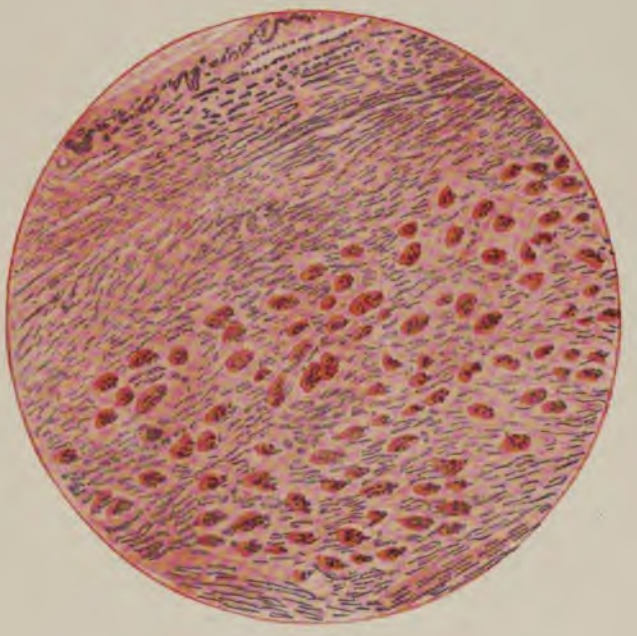


FIG. 232.

Epulis of jaw. Giant cell.

The great majority of rapidly growing tumors of the scapula occurrin in young people are of a sarcomatous nature.

The treatment of sarcomatous growths of the scapula, is the remova ordinarily of the entire bone, and occasionally with this a part of or all o the clavicle, and it may be the entire upper extremity.

SARCOMATA OF THE LOWER JAW.

These are usually giant-cell sarcomata and occur in one of two posi tions, either as a periosteal outgrowth, or as a growth from the medull of the bone. The periosteal outgrowth may take the form of an epulis grow ing upwards along the crown of the tooth, or may spread along the perios teum beneath the mucous membrane, producing quite marked swelling an considerable thickening of the jaw. The epulis is seen as a soft, flesh tumor, having the appearance almost of granulation tissue, and springin

Fig. 233.—Sarcoma of jaw.

seemingly from the gum and projecting upward at the side of the teeth. I is softer than a fibroid epulis, grows more rapidly and bleeds readily. I has nothing absolutely distinctive about its general appearance, and i some cases a microscopic section is requisite for a diagnosis.

A sarcomatous epulis is only mildly malignant and may be successfull treated by extracting the teeth adjacent thereto, and then freely excisin the epulis at the alveolar border of the jaw (Fig. 232).

The sarcomatous growth which takes origin from the periosteum an spreads along the alveolar portion of the jaw should be treated by freel removing all of that portion of the periosteum implicated, as well as th underlying bone.

tion of bone and the infiltration of adjacent structures. If necessary an osteoplastic flap of the anterior wall of the antrum may be made for diagnostic purposes.

TREATMENT.—The treatment of a sarcoma springing from the antrum is ordinarily excision of the corresponding maxillary bone. One of the best external incisions used for this purpose is Ferguson's, slightly modified, and which commences near the external angle of the orbit and passes along the lower border to near the internal angle, and then follows the groove down the side of the nose, passing the alæ to the center of the lip, which it divides. The flap is reflected from the bone and the periosteum divided along the line of the skin incision. A few light strokes of the mallet upon a sharp chisel will divide the nasal process of the superior maxillary, the lachrymal, ethmoid and the floor of the orbit. Then the malar process of the superior maxillary is divided with a chain saw, cutting from within outwards. The soft palate is separated from the horizontal plate of the palate bone and the periosteal covering of the roof of the mouth upon the affected side divided near the alveolar border, then reflected inwards so as to preserve a covering for the roof of the mouth. The palate process of the superior maxillary and the horizontal plate of the palate bone are divided with a chain saw from behind forwards, as well as the alveolar process of the inferior maxillary bone. The bone is then wrenched out, and the soft tissues are brought into position with a few stitches.

SARCOMATOUS GROWTHS OF THE TONSILS.

These are among the most malignant of all the sarcomatous growths, in that they very early lead to regional and lymphatic infection, internal metastases, ulceration and sloughing, and even serious hemorrhage from the infected tissue. Although these growths may make their appearance at almost any age, they are most frequent in middle life, and occur as soft, rapidly-growing tumors, situated within the structures of the tonsil. They are usually composed, in part at least, of round cells. They are readily differentiated from infectious processes in consequence of the absence of marked fever and a less abruptness of their onset. They also may be differentiated from benign tumors in consequence of their more rapid growth, softer consistency, and the fact that they are not encapsulated, as well as the occurrence of metastases.

TREATMENT.—The treatment should be that of early removal if possible, before regional or distant infection has occurred. If glandular involvement has taken place, including the glands beneath the jaw, and those in the anterior triangle of the neck, a permanent cure is practically impossible. The operation for their removal may be carried out through the mouth or through an external incision. For a malignant growth, especially one of any considerable size, it is best to attack the tumor through an external incision. This may be carried from the angle of the mouth back to the ramus of the jaw. The bone anterior to the ramus may be divided if necessary, and the upper portion turned forcibly outwards. Through this incision the tonsil may be thoroughly excised without severe hemorrhage or difficulty. The maxillary bone is then brought into position if divided,

wired, and the soft tissues united with silkworm gut. The tonsil may also be reached by an incision behind the ramus and body of the jaw, without interfering with the continuity of the bone.

SARCOMATOUS GROWTHS OF THE KIDNEY, BLADDER AND TESTICLE.

This subject has been considered under the head of Genito-urinary Diseases.

ENDOTHELIOMATA.

These growths have excited very general interest among surgeons, clinicians and pathologists during the past few years. Their frequency and importance, however, are still scarcely appreciated. There is also scarcely a doubt but that the endotheliomata are every day mistaken for sarcomata and also for carcinomata. The endotheliomata have been classed as a subdivision of sarcomata. They are like the sarcomata in their clinical course and origin from connective tissue. The endotheliomata come from endothelial cells, the form or species depending upon the situation or structure from which these cells take their origin. Endothelial cells are capable of readily changing their form and appearance and are frequently converted into tissue of a higher order, especially into connective tissue. The endothelial cells lining the serous and synovial membranes, blood and lymph vessels and lymph spaces, are thin and flat, and present distinctive characteristics of form and appearance.

The endotheliomata may primarily be divided into two important species, first, the lymph-angio-endotheliomata, or those tumors coming from the lymphatic vessels, spaces and serous membranes; and second, the hæm-angio-endotheliomata, or those coming from the endothelial cells lining the blood vessels. The second species has a very important subdivision, the perithelioma, which has been called a perivascular hæm-angio-endothelioma.

As subdivisions of the endotheliomata we also have the cylindromata, psammomata and the cholesteatomata.

Tumors of endothelial origin may be solid or cystic, very vascular, or poorly supplied with blood. They may be hard, having the firmness of a dense fibroid, or be soft, corresponding in consistency to a myxoma. The growths vary in size, being large or small, well-circumscribed and seemingly encapsulated, or more or less diffuse, infiltrating the adjacent structures. An endothelioma may be a fungous mass and very cellular, or an irregular, nodular growth, containing a quantity of connective tissue, cartilage or bone. It is ordinarily held that the endotheliomata are only mildly malignant, but that a local recurrence after thorough operative measures may occur. In so far as the ulceration and breaking down of the growths by degenerative processes are concerned, they seem to be less likely to be affected, or less frequently, than are the sarcomata and carcinomata. It is ordinarily stated that the regional lymphatic glands are seldom implicated, and this is probably true. Endotheliomata, however, are to be frequently found which grow rapidly, are extremely destructive of tissue, show marked metastases and early cause the death of the patient. Again they may for years grow very slowly, scarcely increasing in size, and then at once and without apparent cause, take on a rapid growth and show a decided malignancy. In considering the various species we must bear in

mind that these tumors are never entirely pure in the sense that they are composed solely of endothelial cells, but that they, like other growths, contain a variety of different tissues. In fact the endothelial cells ordinarily make up but a very small part of the tumor. The cells, as it were, are but an ingrowth into the spaces of connective, fibrous, cartilaginous, osseous or myxomatous tissue. In the skin the endotheliomata may make their appearance as diffused infiltrations or as circumscribed nodular growths.

HISTOLOGY.—The microscopic structure of the endotheliomata presents a very variable picture. Ordinarily one finds a very considerable connective tissue stroma in the spaces of which the cells appear closely set in numerous long strands. These strands often form a very distinct net-work, and when cut across show solid columns of cells. The arrangement of the structure

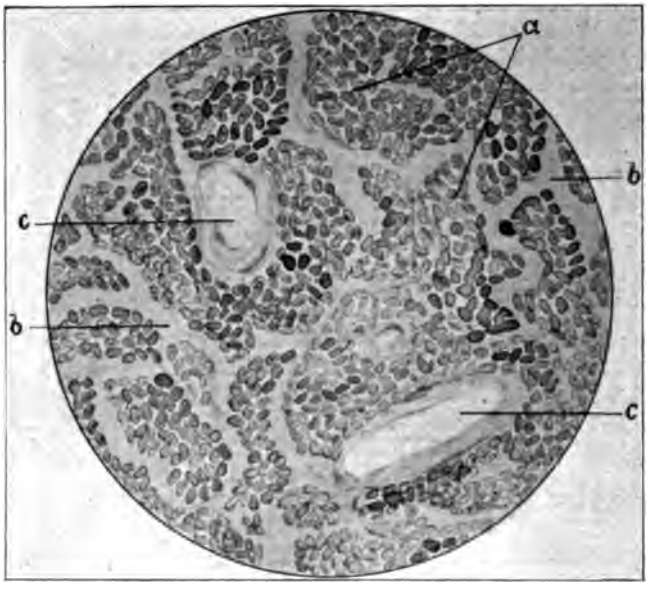


Fig. 234.—Endothelioma of parotid. a. Solid endothelial cell strings. b. Hyaline trabeculæ. c. Vessels with thick hyaline walls.

reminds one of the histology of the lymphatic vessels and spaces, and, as Borst states, it seems as though the cells when in a fluid or plastic state had been injected into these vessels or spaces. At places the strands are much wider than at others, giving one the impression as though the lymph vessels had been dilated into distinct sinuses or cysts. Again the spaces are so narrow as to contain but a single row of cells, or a couple of cells lying in juxtaposition. This is very often the case where the lymphatic spaces are infiltrated, the wider strands or columns appearing like sinuses and occurring as a rule in the dilated vessels. Those cases in which the vessels are decidedly dilated have been spoken of as cavernous, lymph-angio-endotheliomata, and those in which the vessels are dilated to a still greater degree (especially if in circumscribed areas) as cystic-lymph-angio-endotheliomata.

Tubular endotheliomata composed of cuboid cells in tubules with a lumen, are quite like in appearance to normal tubular glands. They are to be differentiated by the fact that they have no basement membrane, and by the further fact that the cells are in direct relation to the underlying connective tissue.

Figure 234 shows a microscopic section of an endothelioma of the parotid gland. The growth was about the size of an English walnut and was situated in the right side. It was enucleated and the wound healed kindly. The microscopic section shows the growth to be a lymph-angio-endothelioma. The cell strands are situated in the lymph vessels and spaces, and are composed of round, cuboid and slightly elongated cells surrounding blood vessels which have undergone hyaline degeneration. Between the strands of cells is to be seen the fibrillated connective tissue stroma in a state of hyaline degeneration.

The cystic-lymph-angio-endothelioma also occurs in the parotid and in the ovary. In the latter organ they are especially frequent and cannot macroscopically be differentiated from an ordinary ovarian cyst. In many cases of endotheliomata in consequence of the cell strands growing into the lymph spaces and producing a net-like formation with distinct separation of the cells from the connective tissue, an appearance is given upon cross section like that of an alveolar sarcoma. The differentiation is made more difficult because the cylindrical or flat epitheloid cells when growing rapidly are pressed together and become polymorphous. In some of the alveolar endotheliomata, in consequence of the cells being situated in nests and spaces and surrounded by a connective tissue stroma, the cells being without an intercellular substance, a picture is produced difficult to differentiate from a carcinoma. The cells in some cases are cuboid or low cylindrical, and being situated upon a connective tissue base in the form of alveoli, each having a lumen filled with a secretion, the appearance is that of an epithelial glandular tumor.

FASCICULAR ENDOTHELIOMATA.

In the membranes of the brain endotheliomata occur which on account of their structure are known as fascicular endotheliomata. They are found as diffuse infiltrating plate-like thickening flat nodes, or as tubular structures. In the [illegible] they have their origin in the endothelial cells of the lymph spaces [illegible] as tissue. The cells retain in a large measure their flat characteristics. Narrow and wide strands of cells are to be seen [illegible] quantity of fibrous tissue which [illegible] an endothelial fibroid. These [illegible] degenerative changes, such as hyaline [illegible] measure the psammomata.

FASCICULAR ENDOTHELIOMATA OF THE PIA.

[illegible] endothelial plates with numer- [illegible] vessels course, all being lined [illegible] proliferating follow the blood [illegible] bundles are pressed about [illegible] arrangement. The cells may

be arranged concentrically or parallel with the blood vessels. On microscopical section the strand when cut lengthwise gives the appearance of being composed of spindle-cells. When cut crosswise the cells look flat. These tumors have often been called flat or spindle-cell sarcomata.

The endotheliomata which occur upon the serous surface are of special interest. They may occur as more or less diffused growths extending over a considerable portion of the membrane, or as innumerable small and distinct or confluent nodules. The growths may be light or dark, in the form of wheels or nodules, simple thickenings, or flat, swelling-like pads. They are usually confined to the surface, not extending into the deeper tissues. Although confined to the surface they are at times as destructive in their growth as the carcinomata and produce metastases in the lymphatic glands, liver, kidneys, muscles, in the suprarenal glands and in the bladder. Endo-

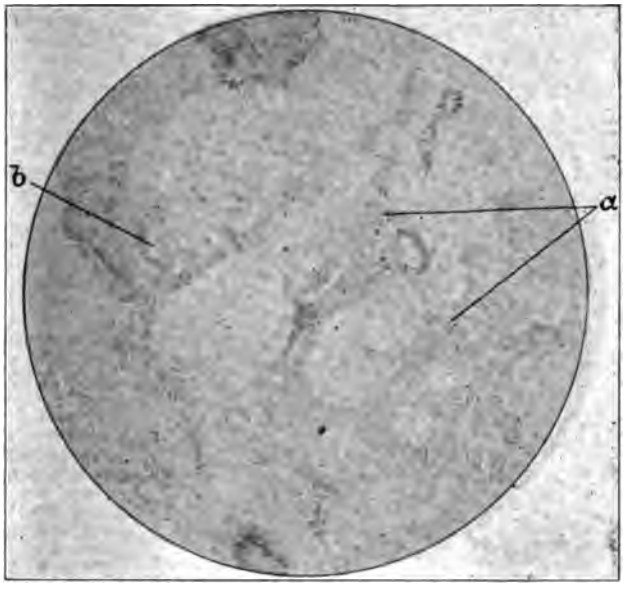


Fig. 235.—Endothelioma of pleura. a. Endothelial cell strings. b. Vacuoles.

thelial growths in these situations are usually attended with chronic inflammation in which there is a serous fibrous or bloody exudate.

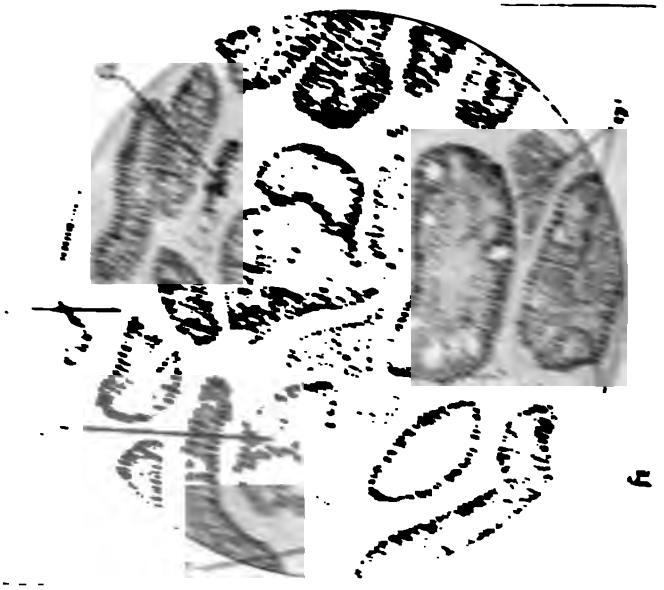
HISTOLOGY.—An especial characteristic of these growths on the serous membranes is the net-like arrangement of the cells, occurring as they do in narrow or broad strands. Their appearance reminds one of the lymph spaces and lymph cavities. The connective tissue of the part is often considerable as the result of proliferation. The cells are often polymorphous. The protoplasm is rich and granular. Cuboid and cylindrical cells occur. In endothelial growths taking origin from the serous surfaces it is a question whether they come from the surface endothelium or from the endothelial cells of the lymph vessels and lymph spaces. The cells of the former

[illegible] girl of 18.

[illegible] vessels. The [illegible] masses of con- [illegible]

[illegible] of the [illegible] arranged in [illegible] spaces. At [illegible] of myxo- [illegible] spaces [illegible]

[illegible]



noticed a small, somewhat sensitive lump in the upper part of the right breast. Insofar as she could remember there never had been any injury to the breast. The tumor had grown rapidly, and at the time of its removal it was as large as a fetal head. The growth was round, globular, had a smooth surface and projected directly forward from the chest wall. The growth was of uniform consistence and gave about the resistance on pressure of a soft fibroid. The growth was freely movable from the chest wall, but had completely enveloped the mammary gland so that it was no longer possible to differentiate the one from the other. In fact, the entire breast seemed of new formation. The axillary glands were enlarged. The girl, naturally thin in flesh, had lost several pounds since the growth made its appearance, and was anæmic, very thin, with sunken eyes and a haggard expression of the face.

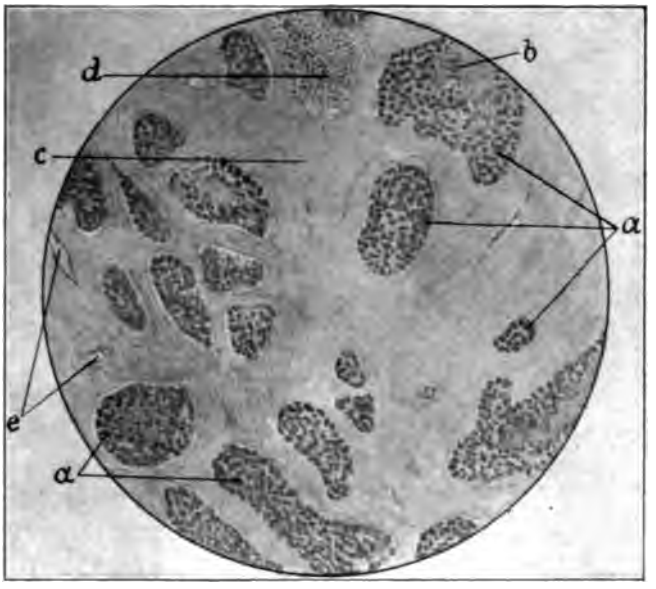


Fig. 238.—Endothelioma of tonsil. a. Endothelial cell strings and nests. b. Mucoid degeneration. c. Stroma d. Lymph follicle. e. Vessels.

Figure 237 shows a microscopic section of the growth. In this section large strands or columns of endothelial cells are to be seen. The center of these strands in places show hyaline degeneration.

Figure 238 shows a microscopical section of an endothelioma of the tonsil. This occurred in a young man, thirty-two years of age; grew rapidly, invaded the adjacent parts, was removed but returned, and finally caused the patient's death. Here large and round strands of endothelial cells are to be seen, between which there is a very considerable stroma in a state of mucoid degeneration.

[illegible] OF THE EARTH

[illegible]

[illegible] OF THE [illegible]

[illegible]

[illegible]

[illegible] OF THE [illegible] THAT RUN

[illegible]

of the ilium. After four months there was a local recurrence. In the microscopical section of the tumor both bone and cartilage were to be found. The connective tissue stroma made up a considerable part of the growth. In this are round and oblong cavities or cysts, more or less filled with flat cuboid cells, which are at times polymorphous and show in places, especially in the cyst-like cavities, hyaline degeneration. In some places only the nuclei are to be seen, the cells apparently having undergone degenerative change. (Fig. 240.)

ENDOTHELIOMATA TAKING ORIGIN FROM THE BLOOD VESSELS.

It has been held by a goodly number of pathologists that endothelial tumors only take origin from the endothelial cells lining lymph vessels,

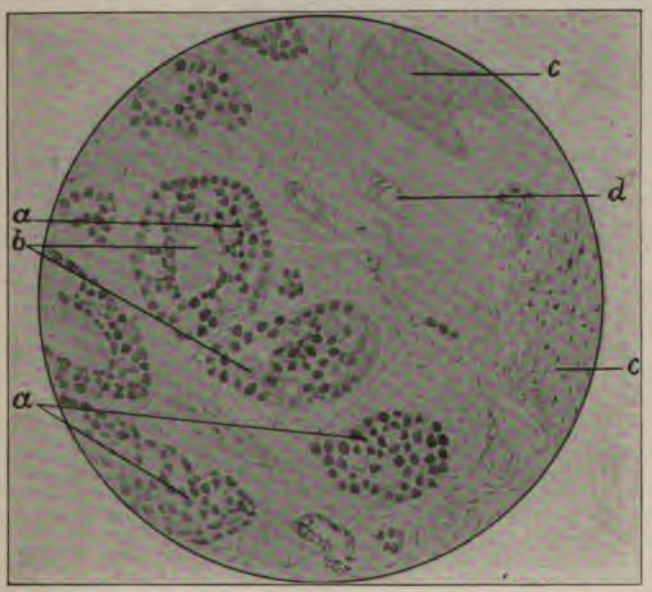


Fig. 240.—Endothelioma of crest of ilium. a. Endothelial cell nests. b. Hyaline masses is cell nest. c. Osteoid spiculæ. d. Blood vessels in fibrous stroma.

lymph spaces and serous membranes. The opinion seems gaining ground, however, and it is undoubtedly a correct one, that endotheliomata under certain conditions take origin from the endothelial cells lining the capillary blood vessels and from the adventitial cells known as perithelial cells, which form a membrane just outside the capillary vessels. The former have been called by Borst hæm-angio-endothelioma intravasculare. Here the primal condition is an excessive outgrowth of capillary vessels. Following this as a second important factor there is a rapid proliferation of the endothelial cells lining the capillaries. The capillary vessels become more or less completely filled with cells in consequence of the rapid proliferation of their endothelium, thus producing more or less solid strands or columns of cells. The cells here are within the vessels and cell strands or cords or

columns consequently take the form and arrangement of the original capillaries.

Figure 241 is a microscopical section of an intravascular endothelial tumor, the proliferating endothelial cells being situated in the hepatic vein, which they partially occlude.

In the second species, the hæm-angio-endothelioma perivasculare, or as it is usually called, perithelioma, the endothelial cells are situated outside the vessels as a thick mantle of large cells. The stroma in both of these species is often deficient, and may disappear, so that in the microscopical cross sections the cell strands or cylinders are pressed close together, while there is but little stroma, or perhaps none, to be seen. The tumor often presents the appearance of a sarcoma or of an angiosarcoma. In fact the

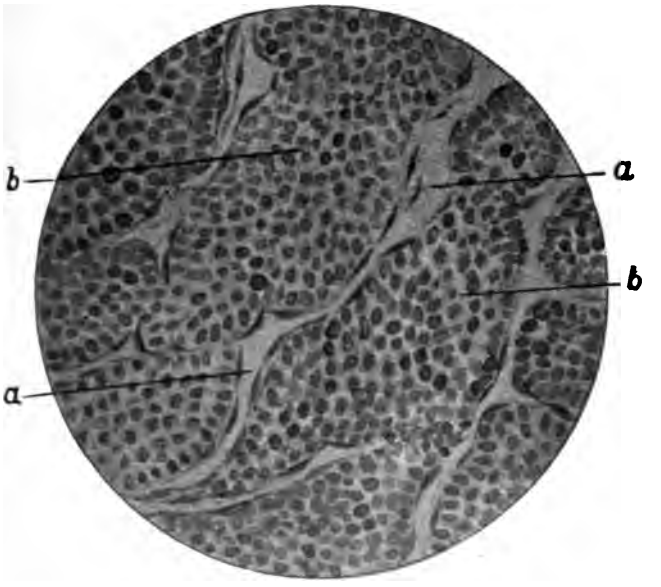


Fig. 242.—Perithelioma of mamma. a. Capillary blood-vessels. b. Endothelial cell masses.

endotheliomata taking origin in the blood vessels have ordinarily been classed as angiosarcomata.

Figure 242 shows a perithelioma of the mammary gland. In this microscopical section, the blood vessels are cut lengthwise; consequently the cells appear as large columns between the vessels. The cells are placed directly upon the endothelial lining of the vessels. The tumor was removed from a young woman aged twenty-four, was the size of an orange and of quite rapid growth.

CYLINDROMATA.

These growths may be defined as a sub-variety of the endothelioma, in which the walls of the blood vessels, and also at times the endothelial strands and stroma, have undergone hyaline degeneration. Hyaline, myxo-

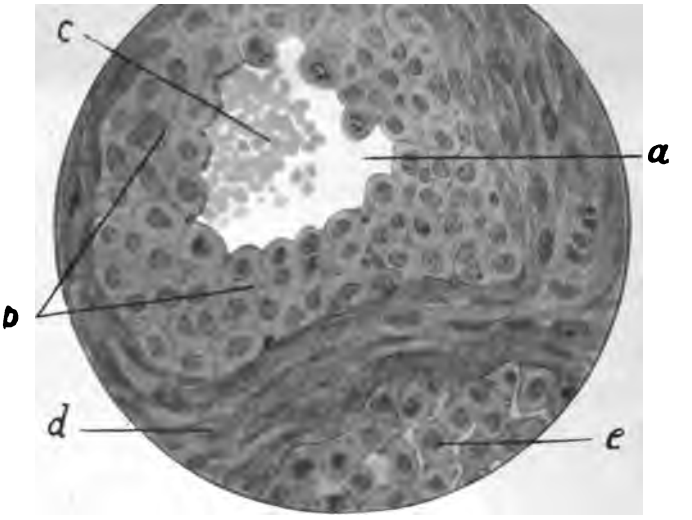


Fig. 241.

Intravascular hæmangio-endothelioma of hepatic vein.

a. Lumen of vein.
b. Proliferated endothelial cells.
c. Red blood cells.
d. Capsule of Glisson.
e. Liver cells.

Fig. 243.

Endothelioma cylindromatosum of nose.

matous, colloid and chalky degeneration occur so frequently in endotheliomatous growths as to become almost pathognomonic. In a cylindroma one finds the growth to be made up in part of gelatinous tissue which occurs in globules, balls or cylinders. This tissue may be translucent or even transparent. In consequence of hyaline, colloid and myxomatous degeneration occurring occasionally in carcinoma, sarcoma and adenoma, these growths have been by some writers classed as cylindromata. In sarcoma, carcinoma and adenoma, however, the hyaline degeneration almost never proceeds so far that the specific cells characteristic of the tumor cannot be distinctively made out.

The two principal forms of cylindromata, which are perhaps also the most frequent, are, first, the perithelioma with hyaline degeneration of the vessels, and second, lymph-angio-endothelioma, with degeneration in part at least of the cells, vessels and stroma. Billroth was one of the first to examine these growths and give them the name of cylindromata. Macroscopically they are nodular growths in which an indistinct alveolar structure is to be seen on cross sections. The periphery is enclosed usually by a fibrous capsule, except in cases showing a decided malignancy, and in these there is only a very indistinct capsule, the growth being more or less diffuse. Microscopically there are to be seen transparent, glass-like, cylindrical and hyaline bodies extending in every direction. Inside of these cylinders, varicose swellings, club-like excrescences, and nodular protuberance presenting a gelatinous appearance, are present. The hyaline bodies are usually homogeneous or they are very faintly striated. Occasionally the fibres contain spindle-shaped nuclei. On section a cylindroma, or a lymph-angio-endothelioma, shows a very complicated stroma containing in many forms and situations endothelial bodies. They appear as small, fine cell strands or tubules. They occasionally occur in twisted form, or as solid cell cylinders, or they seem like cavities or balls.

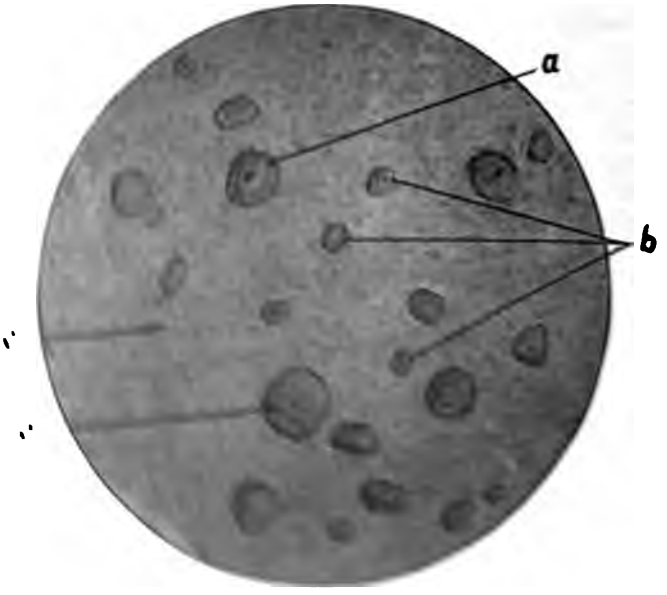
The origin of the hyaline material evidently is varied. It has been held by many writers that it was a product of the cell's secretion, and while these endothelial cells in the normal condition possess little secretory function, they may, when undergoing rapid proliferation, and when forming endothelial tumors, acquire the power of secreting hyaline material in considerable quantity. Some believe that the hyaline material is the result of the degeneration of the cell's protoplasm, the cells becoming soft and confluent and forming hyaline globules, balls or strands.

Cylindromata, both endothelial and perithelial, are found with special frequency in the orbit, parotid and submaxillary regions, in the gums, membranes of the brain and cord, serous membranes and especially in the peritoneum. They are also found in the skin, the bones, the antrum of Highmore, mammary glands, muscles and lungs. Their growth is usually slow. They seldom produce metastases, but recurrence locally after removal is the rule. The endothelial cylindromata are often mixed. This is especially true of those occurring in the parotid gland. The admixture may consist of cartilaginous, myxomatous, sarcomatous or carcinomatous tissue. Muscular tissue has also been found as a part of the endothelial cylindroma.

Figure 243 represents a cylindroma occurring at the border of the nose.

PSAMMOMATA.

[illegible] a specific growth in that sand is found in a variety of [illegible] In many kinds of growths calcareous degeneration of the elements of the [illegible] This is true of the myoma, fibroma, carcinoma, sarcoma and adenoma. In these however, sand is a secondary condition. According to most writers there is but one species of tumor which should be called a psammoma, namely, that taking origin from the meninges and consisting of a new growth of endothelial cells. Virchow described the psammomata as [illegible] chalk-like bodies which take the form of globules or egg-shaped concretions. These, according to Virchow, are not connective tissue tumor. These sand bodies are globular and egg-shaped. The globular sand bodies under pressure break into radiating pieces.



[illegible]

CHOLESTEATOMATA—PEARL TUMORS.

These are partly inflammatory growths and partly real tumors. They have a distinct relationship to the endotheliomata and occur in endothelial cells. Macroscopically they are usually globular and are seen as bullet-like bodies, either occurring as simple or as multiple growths. When multiple they are joined by connective tissue strands into one tumor, or are silk-like pearls of various sizes with short pedicles. Microscopically the layers are made up largely of flat, desquamated cells which are like the epidermis, some having a nucleus and some not. Outside of the layers of cell elements are found glistening cholesterine bodies. There is also found in varying amount a fatty detritus of cells.

Figure 245 shows a cholesteatoma of the dura mater.

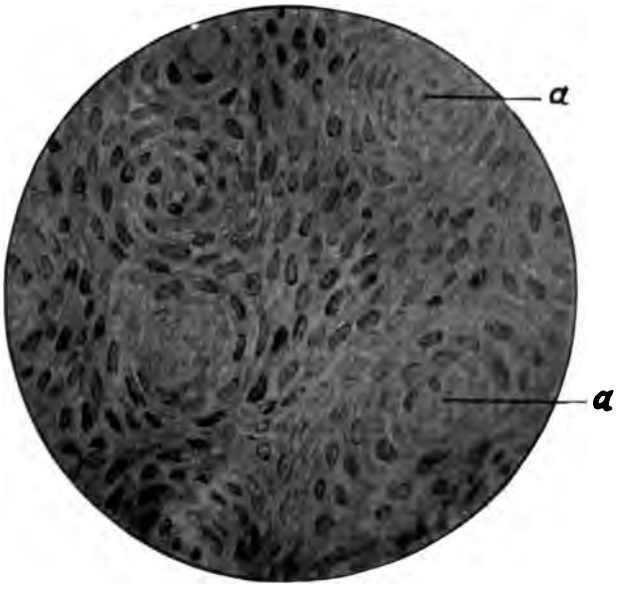


Fig. 245.—Cholesteatoma of dura mater. a. Transparent cell-nests.

THE TISSUE ORIGIN AND LOCATION OF ENDOTHELIAL GROWTHS.—These growths take origin from the endothelial and perithelial cells of connective tissue. They are consequently connective tissue growths. The endothelial cells from which they arise may be those lining the lymphatic vessels or spaces and it is probably true that a very considerable portion of endothelial tumors have their origin from these cells. They frequently take origin from the serous membranes, such as pleura, peritoneum, pericardium, from those covering the brain and spinal cord, also from the serous membranes lining the joint cavities and bursæ and from the tendon sheaths. From the blood vessels they take origin from the endothelial cells lining the capillaries and from the peritheliai cells which separate the wall of the capillary vessel from the lymph channels.

MALIGNANCY OF ENDOTHELIAL GROWTHS.—They are held to be less malignant than the sarcoma and carcinoma in that systemic metastases are less frequent. It is, however, seemingly true that local or regional infections are the rule. It is quite true that some endotheliomata are extremely malignant and many again are almost benign. An endothelioma of the tongue removed by excision has not returned after one and a half years. An endothelioma of the thyroid gland removed by excision has not returned after one year. An endothelioma of the parotid has not returned after six months. Two endotheliomata of the breast have not returned in ten and four months respectively. An endothelioma of the sacrum returned after six months. An endothelioma of the tonsil quickly returned and caused the patient's death. An endothelioma of the innominate bone and of the testicle returned after removal. The malignancy of the pleural endotheliomata is extreme, and usually leads to the death of the patient in a few months.

DIAGNOSIS.—They must first be differentiated from benign tumors, and the endotheliomata may ordinarily be easily differentiated from these

Fig. 246.—Epithelioma of the arm following a burn.

in consequence of the facts that they are without a capsule or well-defined border; they infiltrate rather than push aside the adjacent structure; their growth is rapid, often causing great destruction of tissue; they usually produce metastases observable before operation; and they frequently affect the health and well-being of the individual. In other words, they possess the characteristics of malignancy. From carcinoma they may ordinarily readily be differentiated by the fact that the endotheliomata comes from the endothelial connective tissue cells, while the carcinomata always take origin from epithelial cells. In sarcoma the difficulties of a clinical diagnosis will unquestionably be great. The two classes of growths take origin from the connective tissue and run practically a uniform course. Endotheliomata are, however, as a rule, of uniform consistence, seldom containing cystic cavities which are so characteristic of the sarcomata.

PROGNOSIS.—It may safely be said that the prognosis of the endotheliomata is bad, as they tend to destroy the life of the patient. Their prognosis, however, may, under ordinary conditions, be said to be better than either the sarcomata or the carcinomata.

TREATMENT.—The treatment of endotheliomata corresponds with that of other malignant growths and consists in their removal at the earliest possible moment that a diagnosis can be made.

CARCINOMATA.

The carcinomata may be conveniently divided for the purpose of histological and clinical study into three species: First, the growths having flat or squamous cells and known as epitheliomata; second, those having cylindrical cells and known as carcinomata and found most frequently in the gastro-intestinal canal or the interior of the uterus; and third, those whose cells have no typical form, but take the characteristics largely of the cells from which they spring, and are known as glandular carcinomata.

A carcinoma is made up of two principal constituents. One of these, the stroma, is composed of connective tissue cells. These cells are often

Fig. 247.—Epithelioma of side of face following an injury.

in varying stages of development. Some may be immature, embryonal cells, while others are fully developed into connective tissue. The stroma may form the major portion, or only a very small part of the growth. It may be pre-formed, and be part of the original tissue into which the epithelial cells have grown, or it may be a new formation. The second and most important structure in a carcinoma is the parenchyma, which is composed of epithelial cells. These cells are placed in alveoli, form a reticular structure, assume an atypical, glandular form, or the cells may produce characteristic whorls, pearls and nests.

EPITHELIOMATA.

Epitheliomata are those growths which are composed largely of pavement or squamous cells, which come from surfaces having a stratified squamous epithelium. The cells of these growths are not always flat or pave-

ment-like, but may present the characteristics of any of the cell layers of the skin. They may be composed in part or largely of columnar, cuboidal or polyhedral cells, or the growth may be in part made up of prickle cells. As a rule, however, the dry, horny, squamous epithelium makes up a considerable part of the growth. These tumors take origin from the skin and mucous membranes having a squamous epithelium. Their cells are not confined by the basement membrane, but invade the connective tissue spaces of the deeper structures, as nests, large or small columns, or as a more or less diffused infiltration. The cells are often dry and horny and the parts infiltrated reel to the [illegible] indurated. The epithelial cells in their growth [illegible] accumulate upon the surface of the skin or mucous [illegible] as an excrescence or wart, or as [illegible] the result of an irrita-

[illegible]

[illegible]

[illegible]

shaped, has a few small granulations, or the surface may be covered with a slight amount of necrotic tissue. The base of the ulcer is very decidedly indurated and when picked up between the thumb and fingers for the purpose of examination, feels as though a small piece of pasteboard might have been planted within the superficial tissues. This condition is extremely characteristic and should always be sought for. An epithelioma of the skin or lip is of slow growth, often apparently standing still for months and it may be almost for years. It frequently becomes covered with a crust, during which time the patient may think the ulcer has healed, but upon the removal of the crust the original ulcer is apparent (Fig. 246).

DIAGNOSIS.—The diagnosis will be established largely by the age of the patient, the chronicity of the process, the fact that the ulcer cannot be made to heal by any of the ordinary means of treatment, that it slowly but gradually extends, and especially by the further fact that the base of the ulcer is extremely hard and indurated. Implication of the adjacent

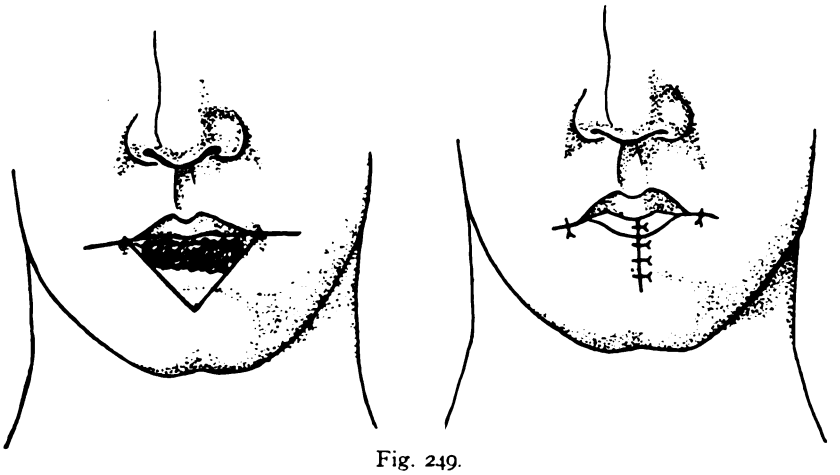


Fig. 249.

lymphatic glands only occurs at a late date and never should be considered necessary in order to establish a diagnosis (Fig. 247).

PROGNOSIS.—Epitheliomata of the skin and lips often run an almost benign course, remaining localized for months and it may be for years. The fact, however, that they invade adjacent and deeper structures and in time the lymphatics makes it advisable that they be removed at the earliest practical moment.

TREATMENT.—In the treatment of cutaneous epitheliomata the Roentgen ray may often be used with success.

EPITHELIOMATA OF THE LIPS.

The removal of these growths as they occur upon the lips, by clean incisions, is still to be recommended. The possible infection of the submaxillary or adjacent glands is especially to be remembered, and when this has occurred these glands should be uncovered and removed. If the growth be superficial and confined to the vermillion border of the lip, it may be

moved by including it in two transverse incisions, leaving scarcely an observable cicatrix or deformity. The surfaces after the excision are nicely coapted by suture (Fig. 248).

If of any considerable size it is best to remove the growth by a V-shaped excision, always going well outside of the induration, so as to include all of the infiltrated tissue. Before making the incisions one should have the coronary artery upon each side controlled by the thumbs and fingers of an assistant, or perhaps better by two pairs of hæmostatic forceps. These should not close too tightly, and be placed near the angles of the mouth. The incisions are closed by interrupted sutures, which include all of the lip, excepting the mucosa, which should be separately united by catgut sutures. (Fig. 249.)

In the technic for excision of an epithelioma of the lower lip, which requires the removal of one-half or more of the lip, the defect may be filled by making transverse incisions from the angles of the mouth

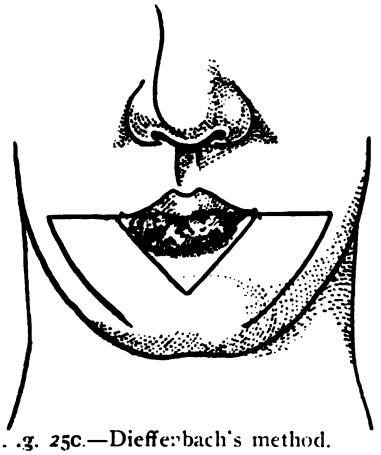


Fig. 250.—Dieffenbach's method.

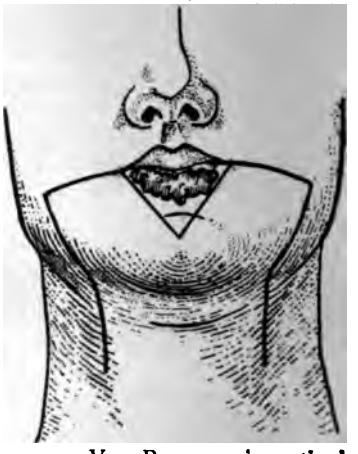


Fig. 251.—Von Bergmann's method.

out upon the cheeks for an inch or an inch and a quarter (Figs. 249a and 249b). These incisions may be supplemented by two perpendicular ones as represented in Figure 250.

The flaps being loosened are slid into place and united in the center line, and the defects, barring the upper angles, are closed by suture. These angles may be closed by skin grafting or allowed to heal by granulation. Von Bergmann in his treatment of epitheliomata which have invaded the entire lower lip, makes transverse incisions from the angles of the mouth out upon the cheeks for an inch and a half or more, and from the outer extremities of the transverse incisions he carries incisions down over the lower maxillary bone, to the neck. This entire flap is turned down, exposing the submaxillary region from which the affected glands are removed. A V-shaped excision is then made of the involved area. The flaps are then united in the median line, stitched at the angles of the mouth, and the defects as far as possible closed by suture. The operation is a very thorough one and when the submaxillary regions are involved, is to be recommended (Fig. 251).

EPITHELIOMATA OF THE TONGUE.

These growths, or more often ulcerations, have many of the characteristics of epitheliomata situated upon the lips and face. The process is much more frequent in men than in women. The condition is primarily seen as an infiltrated, hard area, a small nodule, a slight fissure, or an ulcer. As a first process there may be either a growth of the epithelial cells into the submucous connective tissue or upon the surface. In either case exfoliation of cells soon occurs and an ulcer is produced. The ulcer is most frequently situated upon the side or tip of the tongue. It is at first superficial, well defined, and has a hard, indurated base. The ulcer is often the site of a profuse offensive discharge. It is covered with small granulations

Fig. 252.—Woman, aged seventy-four. Seven months previously an epithelioma made its appearance on inside of lower lip. It extended rapidly and invaded chin, jaw and floor of mouth. Excision of chin, central portion of lower jaw and floor of mouth. Death from shock.

or at times by a mass of necrotic tissue, and causes severe lancinating pains. The ulcer enlarges, sloughs form, the discharge increases, the process not only invades the tongue, but also in time the tonsil, palate, and floor of the mouth. These tissues become hard and indurated, the tongue is fixed, the submaxillary, submental, carotid and parotid, as well as the lymphatic glands in the neck become involved. The patient in consequence of excruciating pain, excessive discharge, invasion of adjacent parts, difficulty of taking nourishment, hemorrhage, and systemic poisoning, is excessively prostrated, greatly reduced in flesh, and finally succumbs to the disease.

DIAGNOSIS.—An epitheliomatous ulcer of the tongue must be differentiated from a simple, a syphilitic and a tubercular ulcer. With these conditions it not infrequently and most unfortunately is confused. In this connection it should be kept in mind that an epithelioma of the tongue occurs only in very rare instances before middle life. A simple ulcer due to traumatism or infection may occur at any age and will heal within a week or ten days if properly protected and subjected to mild antiseptic treatment. Syphilitic fissures often occur at the borders of the tongue during the tertiary stage, but they are without inflammatory induration and are associated with other symptoms of syphilis, while the history will be that of a syphilitic patient.

Syphilitic ulcers are often mistaken for epitheliomatous ulcers. In syphilis there may be a single ulcer or multiple ulcerations of the tongue, and these may be superficial or deep. They are usually the result of the

Fig. 253. Epitheliomatous ulcer of lower lip.

breaking down of one or more gummata and occur upon the dorsum of the tongue. They are preceded by one or more hard areas which soften and then discharge their contents, much as does a furuncle. They have a deeply-excavated cavity with jagged edges, often covered with a considerable amount of necrotic tissue which is the site of a profuse discharge.

Tubercular ulcers are often difficult to differentiate from the carcinomatous ulcer. The tubercular ulcer of the tongue is usually, but not necessarily, secondary to a tubercular process in the lungs or throat. The ulcer is usually situated at the border or tip of the tongue, is chronic, often quite painful, and superficial. The surface is often covered with small, indolent granulations which produce but a slight discharge. The base is only moderately indurated. The absence of anything more than a slight inflammatory induration of the base of the ulcer, with its chronicity, are perhaps the most characteristic differential symptoms.

TREATMENT.—Treatment of an epithelioma of the tongue should be that of excision, the lines of which are carried one-third of an inch outside of any appreciable hardness or ulceration. If the ulcer is small and confined to the border or tip of the tongue, it may be excised by making a curvilinear incision around the ulcer. If the ulcer is of any considerable size it is undoubtedly best to remove one-half of the tongue. Perhaps the best operation for this purpose is that known as Whitehead's. The patient is anæsthetized and placed in a good light, usually in a semi-sitting posture or slightly upon his side. The jaw is held open with a gag, while the cheek upon the opposite side is held back with a retractor. The tongue is drawn out by passing a strong silk thread through the unaffected side, when with a pair of curved scissors the mucous membrane and muscular tissue beneath the tongue and upon the side affected are divided, catching, if one can, the lingual artery before it is cut. The tongue may then be split down the center line and removed at the base near its attachments to the epiglottis. The lingual artery is then ligated. The patient should be put to bed in a sitting posture and the wound kept clean by the frequent use of antiseptic gargles. If the ulcer implicates a considerable part of the tongue the entire member should be removed, following the same technique as before, barring the splitting of the tongue. When one-half has been divided, however, a silk ligature should be passed through the glosso-epiglottidean fold for the purpose of controlling hemorrhage and preventing, when the tongue has been entirely removed, the base falling back upon the epiglottis and causing suffocation. If the glands beneath the jaw are implicated, which unfortunately is often the case, they should be removed. It is taught by Butlin and others that these glands are frequently enlarged and infected in carcinoma of the tongue, without the enlargement being capable of demonstration. For this reason it very properly should be the practice in all cases in which an epithelioma of the tongue is of any considerable duration, to open the submaxillary region and remove the implicated glands.

EPITHELIOMA OF THE TONSIL.

This condition, as is the case with the tongue, is much more frequent in men than in women. It occurs primarily as a node, an indurated area, or as a chronic ulcer. The process is at first superficial and of small extent, but the tendency is towards rapid growth, with the formation of a foul, deeply excavated cavity. The adjacent structures, such as the palate, tongue, pharynx, and submaxillary and cervical glands, are also early involved. The diagnosis is made by considering the age and history of the patient, and noting the characteristics and progress of the ulcer. The patient is usually over fifty years of age, the ulcer will have an indurated base, an abrupt, everted edge, will extend rapidly, be covered more or less with necrotic tissue, and be the site usually of excruciating pain.

PROGNOSIS.—The prognosis in carcinoma of the tonsil is extremely grave, the condition often causing the patient's death in a few months.

TREATMENT.—The treatment, if anything more than palliative, must be undertaken early and consists of complete excision of the growth if possible before the involvement of adjacent structures or neighboring glands

have occurred. The tonsil may be removed, which should take place, if possible, through the mouth. Or the cheek may be split from the angle of the mouth back to the ramus, or the jaw may be divided as recommended in the removal of sarcomatous growths of the tonsil.

CARCINOMA SIMPLEX, OR GLANDULAR CARCINOMA. CARCINOMA OF THE PAROTID GLAND.

Carcinoma of the parotid gland has been thought in the past to be not infrequent, but a more careful microscopical examination of the tumors removed seemed to show that a considerable number, probably the large majority, of malignant growths taking origin within the parotid gland, were either sarcomatous, coming from the connective tissue, or endotheliomatous, taking origin from the blood vessels, lymph vessels or lymph spaces. Carcinomata do occur, however, in this situation, although rarely. The tumor makes its appearance during middle or advanced age, and begins as a small, firm nodule within the substance of the gland. The nodule gradually extends, growing quite rapidly, and soon comes to invade a considerable portion of the gland structure, but it is really an adeno-car-

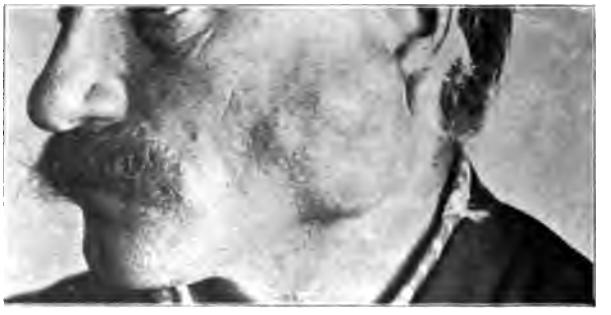


Fig. 254. Carcinoma of the parotid gland in a man aged 51.

cinoma in the majority of cases. In its growth the confines of the gland are overreached, the surrounding tissue implicated and the lymphatic glands of the neck invaded. The tumor becomes attached to the skull and inferior maxillary bone, and it is then quite inoperable. Ulceration is likely to occur, while metastases are frequent in the lungs, bone and liver (Fig. 254).

Diagnosis.—It will be impossible ordinarily to differentiate the different malignant growths taking origin within the parotid gland. The fact that sarcomatous growths occur as a rule in children or young adults and that they have an unequal consistency, being reasonably hard over certain areas, and then again cystic, will lend some aid towards differentiating them from carcinomata. The soft, rapidly growing endotheliomata and soft carcinomata, run practically parallel courses and are not clinically to be differentiated.

Malignant growths in this situation should be differentiated from the benign. The latter occur, as a rule, in young adults, have a slow growth, are confined within the capsule and are freely movable. They are ordi-

narily harder than are the malignant growths, being frequently made up in part at least, of cartilage. The carcinomata grow with great rapidity, are not encapsulated, produce decided pain, and often cause paralysis of the facial nerve. Facial paralysis seems to be almost pathogonomic of malignancy, that is, it seldom, almost never, occurs in benign growths. The paralysis is presumably due to an infiltration and destruction of the nerve fibres.

TREATMENT.—The treatment should be that of excision, which, however, presents unusual difficulties on account of the anatomical relationships.

CARCINOMA OF THE ESOPHAGUS.

Carcinomatous tumors taking origin from the epithelial cells of the œsophagus, are of two kinds: First, the epitheliomata, which represent about ninety per cent. of the carcinomatous growths, and which take origin from the stratified squamous cells lining the surface; and second, the glandular carcinomata, or those which have their origin in the columnar cells lining the mucous glands.

The epitheliomata of the œsophagus have the clinical and histological characteristics of the epitheliomatous growths occurring in other situations. They take their origin from the surface epithelium, and as the result of the vigorous cell proliferation, columns, whorls and nests of cells are formed in the mucous membrane and deeper tissues. The cells are flat, polymorphous or squamous. The growth seldom produces finger-like outgrowths upon the surface, but causes a hard, nodular infiltration, which may extend from one to several inches up or down the œsophagus, or around its circumference, the latter being the more frequent condition. Ulceration occurs early in the infiltrated area, and stenosis soon follows in consequence of the contraction of the new fibrous tissue formed around the cell columns and nests, and also on account of the infiltration.

The glandular carcinomata represent about ten per cent. of the malignant growths of the œsophagus and take their origin from the columnar cells of the mucous glands. These cells proliferate rapidly and acini are formed with many layers of polymorphous cells instead of a single layer of columnar cells. As the result of this cell multiplication, projections, nodes and new glands are formed. The rapidly proliferating epithelial cells of an adeno-carcinoma not only invade the walls of the œsophagus, but project into its lumen as a fungus mass which is likely to cause stenosis and hemorrhage. These growths may be situated in any portion of the œsophagus, but are more frequent in the upper portion, behind the cricoid cartilage or in the middle, where the œsophagus is crossed by the left bronchus.

SYMPTOMS.—In a carcinoma of the œsophagus the first symptoms which are at all distinctive relate to difficulty in deglutition. The patient is usually over fifty and may have shown a loss of appetite and flesh, with weakness and some pain or distress upon deglutition. Before or with these symptoms there is some difficulty in swallowing solid food, associated often with a feeling as though there was a stone or something heavy in the œsophageal region. The food seems to lodge there. After a time the patient is unable to swallow solid food and finds that even liquids must

be taken slowly. The patient now has lost considerable strength and flesh and looks pale and worn. The condition before reaching this stage has perhaps been noticeable for several months. As the stenosis increases, the patient finally is unable to swallow even liquids. Vomiting is also an early symptom; that is, the food or liquids reach the stenosed area and being unable to pass to the stomach, are regurgitated. This occurs usually a few moments after the taking of solid food or liquids, and these return almost unchanged, except perhaps that with them there is a quantity of mucus and it may be some blood.

The diagnosis is rendered more certain if necessary by the passage of a large stomach or œsophageal bougie.

PROGNOSIS.—Death is the inevitable result of carcinoma of the œsophagus if the disease is allowed to take its own course. Death occurs, as a rule, within one or two years.

Fig. 255.—Adeno-carcinoma of stomach.

TREATMENT.—Treatment may be considered under the head of prophylactic and surgical. The former consists in providing proper nourishment for the patient. Before the stenosis becomes complete the patient will be able to pass a quantity of liquid food into the stomach, if it is taken slowly and at frequent intervals. In this way the patient is nourished, though perhaps imperfectly, for a considerable time. Following this, or in conjunction with it, rectal feeding should be restorted to. Predigested milk, eggs in milk, beef-tea, malted milk or other liquid foods may be administered.

Early in the course of the disease the question of gastrostomy should be presented to the patient for his consideration. In carcinoma of the upper portion of the œsophagus, excision has been successfully performed.

CARCINOMA OF THE STOMACH.

Cancer in this situation has been divided by pathologists into three species: First, the cylindrical cell or adeno-carcinoma; second, the hard glandular carcinoma, or scirrhus; third, the mucous or colloid carcinoma (Fig. 255).

Fig. 256.—Adeno-carcinoma of stomach

It is necessary pathologically, and so far as possible clinically, to differentiate these species, as they run different courses and have varying degrees of malignancy. The adeno-carcinoma is a soft, glandular tumor, which

Fig. 257.—Adeno-carcinoma of stomach, laid open.

makes its appearance upon the inner surface of the mucosa as an irregular growth, covered with small fungous elevations. The fungous or finger-like outgrowths upon the surface of the tumor are delicate processes, each

one of which contains a blood vessel surrounded by a column of cells. Its rich blood supply gives the neoplasm a red color, and is the occasion of more or less frequent hemorrhages. Microscopically the glandular arrangement is distinct. If the tubules are cut across they are seen to be very irregular in size and shape, and the cells, instead of constituting a single layer

Fig. 258.—Scirrhus of stomach. a. Pylorus. b. Body of stomach. c. Gastro-colic omentum with enlarged glands.

of cylindrical cells, are in many irregular layers or fill the lumen of the tubules. The cells are also irregular in form (Figs. 256 and 257).

The adeno-carcinomata are most frequent in the pyloric region. They have their origin in the pyloric glands and seldom extend into the duodenum. Regional infection occurs in the walls of the stomach, although late. Metastases take place in the liver, and in the adjacent glands, especially those

about the lesser curvature. The process infiltrates the walls of the stomach and adhesions are frequent between the pylorus and liver and between the anterior wall or greater curvature of the stomach and colon. Disintegration and necrosis occur, and in fact the greater portion of a tumor may slough away, leaving an ulcer which extends into the wall of the stomach, or one which causes perforation (Fig. 257).

Scirrhus of the stomach is represented by a hard, glandular form which differs from the species already considered, largely in consequence of its hardness. A scirrhus growth here or elsewhere does not produce a tumor of any considerable size. It is simply a thickening and hardening of the part affected. This induration started in the pylorus may invade practically the entire walls of the stomach. The surface affected often shows superficial ulceration. These ulcerations are flat, smooth and have a hard base. The histological structure of a scirrhus of the pylorus does not differ materially from that of a scirrhus situated elsewhere and consists largely of a stroma with a lining of epithelial cells which occur in slender strands, in nests or whorls (Figs. 258 and 259).

In carcinoma of the stomach metastases may occur in the liver and in distant organs, adhesions are frequent between the pylorus and liver, the pylorus and transverse colon and the pylorus and omentum. In stenosis of the pylorus the stomach ordinarily becomes very much dilated. In stenosis of the cardiac extremity the stomach often becomes contracted.

Situation and Age. According to Orth sixty per cent. of all gastric carcinomata affect the pylorus; twenty per cent. the lesser curvature, ten per cent. the cardia and ten per cent. the remaining portions. Gastric cancer makes up from thirty five to forty per cent. of all cancers. In the middle region of the stomach a carcinoma is often confined to a limited area, whereas at the two extremities it often invades the entire circumference of the organ. Ninety per cent. of the cases appear between the fortieth and seventieth year and ninety-five per cent between the thirtieth and seventieth year.

Causation. Hereditary influence here as elsewhere frequently plays some part in the production of carcinoma. In one hundred and fifty cases Osler found there were eleven in which heredity seemed to be an important factor.

Ulcers. There is now no question but that ulcers of the stomach are frequently the cause, directly or indirectly, of carcinoma, and that the process becomes engrafted upon an ulcer or is caused by the irritation of the cicatricial tissue formed in the healing process. A very frequent cause, apparently, of carcinoma of the stomach is a dyspeptic or catarrhal condition produced by improper food or alcoholic drink. Here as elsewhere anything which produces and maintains an irritation and increases the blood supply is likely to lead to cell proliferation and in the end may be a causative factor of carcinoma. It is almost proverbial that the regular drinker of alcoholics is predisposed to carcinoma, and he whose stomach is more or less in a state of chronic irritation in consequence of the ingestion of improper food is also predisposed to carcinoma. It is claimed that in more than seventy per cent. of the cases of gastric carcinoma the patients have been steady drinkers of spirituous liquors. Carcinoma is said to affect the

stomach more frequently than any other organ of the body, excepting the uterus. Carcinoma of the stomach affects men more frequently than women, in the ratio of about three to two. According to Berry and Shaw, the average age at which carcinoma appears is 51.1 years.

Fig. 259.—Scirrhus of stomach, laid open. 1, 2 and 3. Wall of stomach showing marked thickening. 4. Crater-like cavity.

SYMPTOMS AND COURSE.—The symptoms of carcinoma of the stomach, when not situated at the cardia, may make their appearance suddenly or steal on the patient so insidiously and gradually that he is unable to determine the time of their first appearance. In rare cases the symptoms may

be wanting, the process remaining latent until death. The first symptoms ordinarily are those which are usually ascribed to dyspepsia. After meals there is pressure and fullness in the stomach with eructation of gases. Then comes loss of appetite, nausea and vomiting. Cardialgia and a coated tongue, thirst and constipation of the bowels follow. Pain as a symptom varies greatly. At first it is difficult for the patient to define what he feels. The feeling is often described as one of distress or uneasiness, an unpleasant sensation which may occur after eating, or it may be quite independent of the taking of food. The pain primarily is slight and insignificant, but later becomes a matter of considerable moment. There is often after a time a heavy, dragging feeling in the stomach, severe distress or a piercing, lancinating pain, or there may be paroxysms of pain of greater or less severity, during which the patient suffers severely. The pain of carcinoma is not always relieved by vomiting, nor exaggerated by the taking of food.

Vomiting is present sooner or later in nearly every case. Its character will depend upon the position of the growth. If the tumor is situated in the cardia, especially if producing obstruction, there will be primarily a difficulty in swallowing solid food, and after a time an inability to swallow liquids, except slowly and in small quantities. The vomiting which occurs in cardiac stenosis is likely to be immediately, or shortly, after eating or drinking, and to be the materials that have been swallowed, in practically an unaltered condition. In carcinoma of the pylorus the vomiting as a rule only occurs after the other symptoms of stomach trouble have become pronounced. If stenosis of the pylorus and subsequent dilatation of the stomach take place, vomiting becomes more frequent and the quantity ejected large. It occasionally happens that the material vomited during the first stage will show upon microscopical examination portions of undigested food, bacteria, and red blood corpuscles. The latter are of diagnostic significance. Often in the course of the disease, as the stenosis becomes pronounced and the retention of food and liquids marked, ulceration of the growth occurs and in consequence of this hemorrhages take place in the stomach. Hæmatemesis, though not abundant, is usually a frequent symptom of carcinoma of the pylorus and lesser curvature. If the blood remains in the stomach for a time, its pigment is changed into hæmatin, and this being uniformly mixed with the gastric contents produces the "coffee-ground" material which is held to be so characteristic of gastric carcinoma.

Free HCl is absent in the great majority of cases of carcinoma. In ninety-four cases examined by Osler it was absent in eighty-four. It is held by a great majority of writers that free HCl is absent practically in all cases of carcinoma of the stomach which are primary. In those which have their origin from a gastric ulcer, free HCl is usually present. The absence of free HCl depends largely upon the destruction of the mucous membrane of the stomach, in consequence of the invasion of the growth. The absence of free HCl is also noted in chronic gastritis, atony of the stomach, and in certain nervous affections. The symptoms and course of these diseases are quite different, however, from those of carcinoma.

The presence of lactic acid in the stomach contents is also of diagnostic worth. This acid is the result of fermentation produced by micro-organisms upon the carbohydrates and is practically always present in cases of ob-

struction of the pylorus by carcinoma. [illegible] are necessary in order to produce excessive [illegible]

1st. Impaired gastric peristalsis. [illegible]

2d. Absence or great reduction [illegible]

3d. Reduction of albumen digestion.

4th. Impaired absorption.

The Oppler-Boas bacillus occurs in [illegible] a certain extent characteristic of carcinoma [illegible] however, in a case of benign stenosis [illegible] was found in 1895 by Oppler in the [illegible] Hemmeter found this bacillus in fifty [illegible]

Progressive emaciation is one of [illegible] this disease. It is quite true that in [illegible] continuous. Patients may have periods [illegible] not lose weight, but may even [illegible] however, the loss of weight is [illegible] months will reach from twenty [illegible] is sometimes experienced may be [illegible] diet, an operation or a fat [illegible] keeps pace with loss of weight [illegible] gressively weaker from month [illegible] be from day to day.

The patient's appearance [illegible] cancerous cachexia, so-called [illegible] weakness, a lemon color of the [illegible] eyes, is often pronounced. [illegible] toxæmia.

It is claimed that fever [illegible] tion of temperature. This may [illegible] usually of short duration. [illegible] much of the ingested food [illegible] constipated. The urine [illegible] casts.

As the result of the [illegible] and in consequence of [illegible] stomach are always reduced [illegible] lions per cubic millimeter. [illegible] ratio, averaging about [illegible] changed.

In a short resumé of the [illegible] of carcinoma of the stomach [illegible] fifty and sixty-five years [illegible] epigastric region after eating [illegible] In progress of time the [illegible] associated with vomiting. [illegible] material increases in quantity [illegible] appearance. A chemical examination of the [illegible] and the presence of lactic acid [illegible] bacillus.

In cases of carcinoma of the pylorus with narrowing of its lumen, the stomach will become markedly dilated. A tumor may be detected during some part of the course in eighty per cent. of the cases. The right rectus is often tense, the ankles are frequently swollen, and an examination of the blood will ordinarily show a diminution of the red blood corpuscles to about two million per cubic millimeter, and a reduction of the hemoglobin to about forty-four per cent.

The above symptoms are very conclusive of carcinoma of the stomach Under normal conditions the pylorus is situated to the right of a perpendicular line passing through the ensiform cartilage and symphysis pubis. The remainder of the stomach is situated to the left of this line.

Gastric tumors which are not confined by adhesions are usually very movable. This is especially true of tumors situated in the body or fundus of the stomach. They may be pushed to almost any position in the upper abdomen. They are often depressed slightly upon inspiration, and are with few exceptions the most movable tumors situated in the upper abdominal region.

They must be differentiated from neoplasms taking origin from the liver. In hepatic tumors the characteristic border of the liver may usually be felt with its longitudinal notch. A neoplasm of the liver is also dull upon percussion and the liver is usually tender and somewhat enlarged. The liver descends upon inspiration, while under ordinary conditions the stomach, although descending somewhat, does not change its position so pronouncedly as does the liver. In tumors of the liver there is not likely to be dilatation of the stomach, absence of HCl, or the presence of lactic acid. In tumors of the stomach, when the organ is filled with water, the area of dullness produced by the tumor runs into or becomes a part of that produced by the water. This would not be the case with a tumor of the liver. In a tumor of the stomach, if the organ be inflated with gas, there will be resonance above and below the tumor. A tumor of the stomach is often resonant on percussion. This is especially true of tumors situated in the posterior wall. Tumors of the liver will often show hepatic disturbance and jaundice.

Gastric tumors should be differentiated from splenic tumors. Sixty per cent. of the malignant tumors of the stomach are situated in the pylorus to the right of the median line. These tumors at least will be readily differentiated from tumors of the spleen. The spleen has a sharp border which is characteristic, is dull upon percussion, and will not be the cause of dyspeptic symptoms or of dilatation of the stomach, which are usually present in gastric carcinoma.

Tumors of the transverse colon are to be differentiated. These frequently present great mobility and may sink downwards as far as the pelvis. In tumors of the colon the filling of the colon with air or water may give characteristic symptoms. A tumor situated in the stomach is often pushed out beneath the ribs or behind the ensiform cartilage when the colon is filled. A tumor situated in the posterior wall of the colon will disappear if air is made to fill the colon. If situated in the anterior wall it will be made more prominent. In tumors of the colon stenosis is likely to occur and this will be associated with acute symptoms, such as great pain, persistent vomiting, tenesmus and dilatation of the canal above the stenosed area.

The conditions should be differentiated from benign ulceration of the stomach. Ulcers of the stomach run an acute or chronic course. The acute ulcer is observed most frequently in young anæmic girls and is attended with more or less pain. The pain is localized and associated with a distinct, well circumscribed area of tenderness. The pain is increased by the taking of food and relieved by vomiting. The latter often occurs shortly after each meal. In the acute ulcer hemorrhages not infrequently occur, and the amount of HCl is usually increased.

The chronic ulcer, which is more likely to be mistaken for carcinoma, occurs in middle life or at an advanced age. There may have been an acute ulceration followed by years of gastric pain and more or less vomiting, periods of relief or apparent healing being followed by others in which there is a recurrence of pain and gastric distress. Chronic ulcer may be the site of severe and frequently repeated hemorrhages. It may lead to decided thickening of the area involved, and cause perforation into an adjacent hollow viscus, as the bowel, pleura or pericardial sac. It may open into the lungs or into the peritoneal cavity. In chronic ulcer, free HCl is usually increased while the course is more chronic and the stomach not usually dilated.

DIAGNOSIS.—This may be approximately established in the early stages by considering the history, examining the contour, size and motility of the stomach, as well as the stomach contents. It is claimed by Hemmeter that if the stomach contents be carefully and systematically examined by allowing the solid particles to settle in a conical glass, that these will often show atypical epithelial cells practically characteristic of carcinoma.

PROGNOSIS.—The prognosis of carcinoma of the stomach without operative interference leaves absolutely no ray of hope for the comfort or life of the patient.

TREATMENT.—*Carcinoma of the Cardia.* Unfortunately, as has been already stated, a carcinoma in this situation can receive only palliative treatment. This should consist in providing suitable nourishment for the patient, in relieving pain and possibly in doing a gastrostomy. What has been said under the treatment of carcinoma of the œsophagus will hold good in carcinoma of the cardia.

In regard to gastrostomy, Zesas collected one hundred and thirty cases from the literature, and among these 19.5 recovered without [illegible] the operation so that it might be called a success. If the operation is to be performed it should be done early before great debility has occurred and while there is a fair prospect of the patient withstanding the shock of the operation.

Carcinoma of the Pylorus and Body of the Stomach. [illegible] experience has shown that these cases, if they are to be treated [illegible] be operated on early. If one waits until a tumor can be felt [illegible] great majority of cases regional infection, metastasis and adhesions to adjacent organs have occurred, rendering a successful operation an absolute impossibility. That the results of surgery of the stomach have not been better is very largely the fault of the physician. Patients have often been led to believe that they must wait until a tumor be palpated or even [illegible] operation could be done. Everyone knows that then there is little hope

from operative intervention. There has been in the past too much of waiting and too great attention given to the apparent importance of frequent examinations into the chemistry of the stomach contents and not enough of surgery. What is wanted is not a better surgical technique, but a knowledge of the fact that carcinoma of the stomach is primarily limited to a small area, which ordinarily may be easily removed. More frequent exploratory operations are wanted for the purpose of diagnosis, and less of diagnostic niceties in the way of chemical analysis, unusual symptoms and waiting for a neoplasm. It is stated by Hemmeter that it is better to make an occasional exploratory operation and find that the patient is not suffering from carcinoma of the stomach, than to allow a case to go without surgical interference, and find at the autopsy that the patient had been suffering from

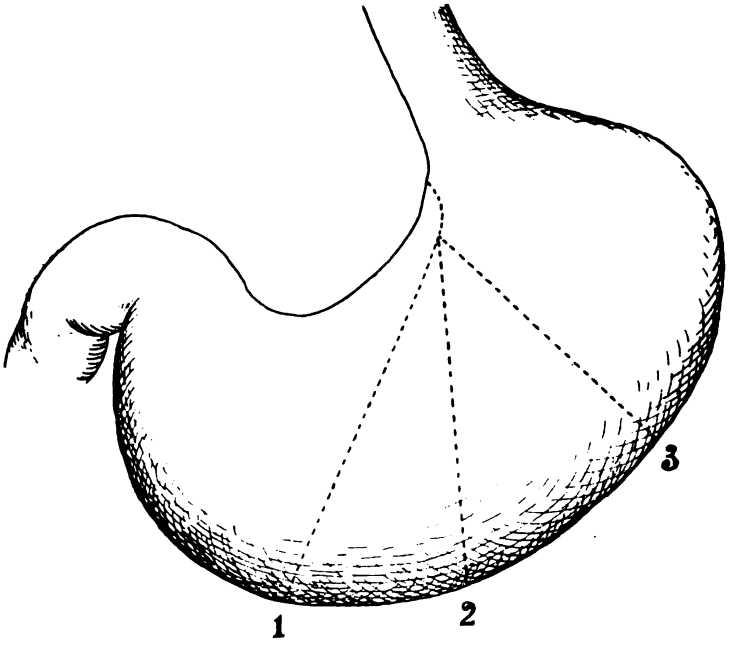


Fig. 260.—Lines of excision practised by different surgeons. 1. Hartmann. 2. Mikulicz. 3. Robson, Moynihan, Mayo.

a well circumscribed tumor that could have been easily removed. Hemmeter advises operations under the following conditions: 1st. When dilatation is associated with catarrh. 2d. The absence of HCl in the gastric contents. 3d. Excessive lactic acid. 4th. The presence of the Oppler-Boas bacillus.

Symptoms of stenosis when accompanied by these signs are held as indicating an operation, even in the absence of a palpable tumor. Hemmeter says he personally always urges operations when the first three conditions are persistently present and the case does not improve after three weeks of appropriate treatment.

Cases Suitable for Resection.—This class represents those growths irrespective of size situated to the left of line 3 (Fig. 260) in which there are no distinct metastases, and few if any adhesions to adjacent organs.

The operative technique [illegible] off the gastro-colic and gastro-[illegible] [illegible] are clamped at least [illegible] cision, which if possible [illegible] the limit of apparent [illegible] is then excised and the [illegible] three rows of [illegible] the jejunum and the [illegible]

CARCINOMA OF THE INTESTINES

Carcinomata of the [illegible] very closely to [illegible] divided by pathologists [illegible] the cylindrical cell [illegible] ture. Second, the [illegible] very malignant [illegible] generally held to be [illegible] the epithelioma [illegible]

The cylindrical [illegible] and is generally [illegible] its origin in the [illegible] differ to any extent [illegible] from within the stomach [illegible] distinct species, but this [illegible]

Cancer of the intestines [illegible] of the stomach. It may [illegible] in the duodenum, jejunum, [illegible] tum. In fact, there is no [illegible] may not have its origin. [illegible] intestines, but are found most [illegible] colon and sigmoid. Carcinoma [illegible] cinoma of the stomach, [illegible] uterus and ovaries.

METASTASES.—Metastases may [illegible] channels. The process is ordinarily [illegible] infrequent occurrence, at least during the early stages. The glands in the mesentery and the retroperitoneal glands are frequently primarily implicated. In cancer of the rectum the retroperitoneal, sacral and lumbar glands may be implicated. The inguinal glands are only affected in case the process invades the skin. In carcinomatous processes of the intestine, adhesions with adjacent organs are likely to occur as soon as the process has implicated the peritoneal covering of the bowel. Adhesions between colon and stomach, and between the small intestine, bladder, uterus, ovaries and parietal peritoneum are of frequent occurrence. Perforation has occurred in carcinoma of the intestines as the result of sloughing, digestion and disintegration of carcinomatous masses. When adhesions have preceded the process, the intestinal contents may be discharged into the intestine which has become adherent or into the bladder. If there are no adhesions, the discharge will be into the peritoneal cavity, resulting in acute peritonitis.

Pathological Anatomy.—A malignant growth situated in the intestines is made up of parenchyma and stroma. The tumor may be rich in cells while the stroma is small in amount, producing a medullary carcinoma, or the stroma may be excessive and the cells but few, and placed in slender strands, producing a scirrhus. The growth appears primarily as a hard nodule or plate within the mucous membrane, or as a soft, ragged mass, projecting into the lumen of the intestine. As the growth extends it infiltrates the wall of the bowel, it may be, both circumferentially and perpendicularly. Ulceration sets in and this may be represented by a flat, annular ulcer, which extends around a part of the bowel or encircles its entire circumference. As the growth continues the lumen of the bowel becomes

Fig. 261.—Carcinoma of colon.

contracted in consequence of the infiltration of its walls and the contraction and sclerosis of its connective tissue. A tumor may grow in the lumen as a medullary mass obstructing the intestine. If the lumen is obstructed by a soft mass its continuity may be re-established in consequence of the sloughing and disintegration of the tumor tissue.

Carcinomata of the intestines occur most frequently in persons between the ages of forty and sixty. The disease seems more common in men than in women. (Figs. 261 and 262.)

Symptoms and Course.—In the great majority of cases of carcinoma of the intestines the disease develops so insidiously that it is difficult and

usually impossible to determine anything like the date of its commencement. Many cases go on to emaciation, cachexia and death, the condition not being discovered, and perhaps not even suspected, until an autopsy is made. Ordinarily the nearer the disease is situated to the stomach the greater the functional disturbance. It may be that emaciation is the first thing noticed, but the appetite may remain good and the patient hold his weight. Frequently the first indication is some disturbance of the function of the bowels. Among the more pronounced symptoms are increasing constipation, with occasional attacks of diarrhœa, and with perverted and increased peristalsis. The patient finds that there is a constant and increasing difficulty in getting the bowels to move, and with this constipation there is decided flatulency, with colic and with increased peristalsis and often very severe diarrhœa. There

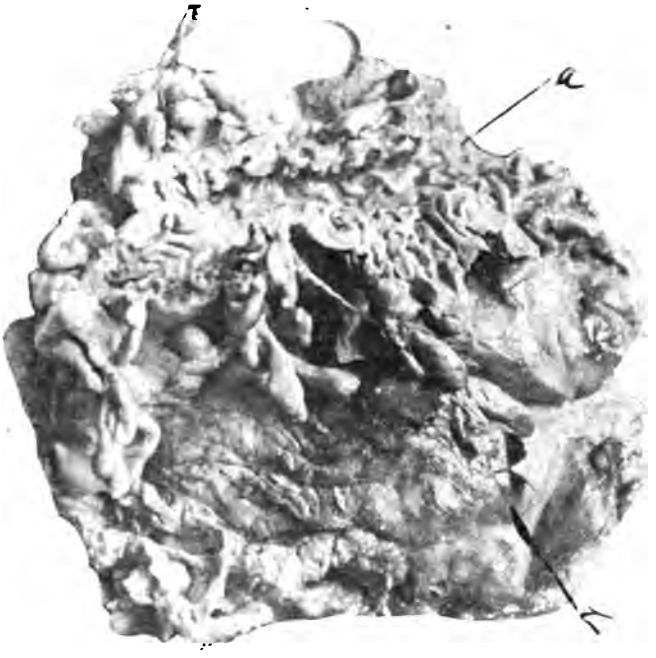


Fig. 262.—Carcinoma of colon laid open. a, and b, Thickened walls.

may at the same time be a feeling of oppression, or fullness and tension in the abdomen. The appetite may not be disturbed for a considerable time, and this is especially true of carcinomata situated low in the canal. As the growth progresses obstruction may become complete, with all its untoward symptoms, such as nausea, vomiting, great pain, distention of the abdomen, obstinate constipation and collapse.

A tumor may be felt in about thirty per cent. of the cases. The enlargement is made up not wholly by the growth, but also, and this is frequently the case, by the agglutination of neighboring intestines. In a considerable majority of the cases a tumor is not to be felt until a late stage. In seeking for the tumor the examination should be made after the bowels are thoroughly emptied, and then again after they have been filled either

with water or air. Repeated examinations should be made, if necessary.

A tumor of the intestines usually has the following characteristics: It is hard, nodular, and unless fixed by adhesions, freely movable. If situated in the more movable parts of the intestinal canal it may sink down to the pelvis; if situated in the cæcum or flexures of the colon, it may be quite immovable; but when situated in other parts of the intestinal canal, the tumor can often be pushed in almost any direction.

Pain is seldom present to any considerable degree before obstruction occurs. Superficial soreness and heaviness are common, and pain may be induced by the infiltration of the walls of the bowel and by the weight of the tumor dragging on the intestines.

Increased peristalsis is one of the most characteristic symptoms of obstruction. It usually comes in paroxysms, which may recur every few moments, or only once in a quarter or half an hour. These paroxysms are the occasion of a good deal of pain and distress, and throughout the attacks the coils of intestines can be outlined distinctly against the abdominal wall and can be seen and felt to undergo excessive motion. During the paroxysms there is more or less gurgling within the bowels. This increased peristalsis is Nature's method of trying to overcome the stenosis. The bowel above the stricture is likely to become hypertrophied, dilated and filled with fluid or solid fæces. The intestines above the stricture are, during the paroxysm, in constant motion, while the bowel below remains quiescent and is more or less collapsed. In watching one or more paroxysms, one can often locate more or less exactly the site of the stenosis. If it is at the ileo-cæcal valve, or near that region, contortions will occur in the small intestine, while the flanks and region of the transverse colon will be quiescent and more or less flat. If situated in the sigmoid or rectum the entire abdomen will be prominent and will show laterally as well as centrally, intestinal contortions.

TREATMENT.—Treatment should consist in resecting the portion of bowel implicated, or an artificial anus may be made or an anastomosis done above and below the tumor, short circuiting the fæcal current.

CARCINOMA OF THE RECTUM.

Carcinomata are more common in this situation than in any other portion of the intestinal canal. They frequently occur as adeno-carcinomata, although the scirrhus form is occasionally found. At the anus an epithelioma is not infrequently seen. The growths are usually situated from three to eight inches above the anus, and in their development either extend upwards, following the course of the blood and lymph vessels, or encircle the bowel.

Primarily there is a proliferation of cells within the mucous membrane, which produces a hard node or plate. This gradually spreads upward, downward and circumferentially until a ring more or less completely surrounds the rectum. The perpendicular extent of such a growth is seldom more than a few inches. Upon its surface are irregular nodes, flat plates, or papillomatous outgrowths. After a time disintegration sets in and the surface becomes covered with a hard, smooth ulcer. The constriction which always occurs is due to the infiltration of the walls of the rectum and to the subsequent contraction.

The medullary carcinoma as it occurs here is a soft, fungous growth, which projects into the lumen of the bowel. In this species, ulceration, disintegration and sloughing are the rule. Mucus, pus, blood and fragments of the neoplasm may be found in the evacuations. (Fig. 263.)

An epithelioma, that is, a squamous cell carcinoma, occurs at the border of or within the first inch of the anus as an indurated node, flat, hard area or ulcer. It has the characteristics of the epitheliomatous induration or ulcer as seen elsewhere.

SYMPTOMS.—Often the first symptom of carcinoma of the rectum is an increasing difficulty in evacuating the bowels. This symptom as a rule does not make its appearance until the growth is of several months' duration. Very frequently the condition is thought to be one of piles, as blood and

Fig. 263.—Adeno-carcinoma of rectum.

mucus are not infrequently passed with the fæces. In a considerable number of cases, especially after ulceration has occurred, there is soreness, tenderness, a feeling of fullness in the rectum, and occasionally severe pain when the bowels are evacuated. (Fig. 264.)

Hæmorrhoids are usually present and there is occasionally a very decided tenesmus, the patient feeling as though there was some hard substance in the rectum which should be expelled. It occasionally happens when these patients go to stool, in consequence of the tenesmus, that the hæmorrhoids, and often the mucous membrane of the rectum, with the growth, are pressed out through the external sphincter.

DIAGNOSIS.—The diagnosis can be established in these cases by making a rectal examination. If the growth is situated high up this may be done under an anæsthetic.

Differential Diagnosis.—Malignant neoplasms should be differentiated from benign growths and from cicatricial contractions. The age of the patient is presumably important. Tumors occurring in young persons and being freely movable and having a pedicle, are generally benign. A history of previous dysentery or syphilitic ulceration would be presumptive evidence of cicatricial stenosis, in the absence of a tumor. In cicatricial stenosis of the rectum the stricture is usually much thinner, has a smooth surface, is often without the presence of ulceration, is semi-elastic, and does

Fig. 264.—Villous carcinoma of rectum.

not present the infiltration of the walls of the bowel as does a carcinomatous process. In syphilis the differentiation will be at times extremely difficult, in that the induration of syphilis usually extends for a considerable distance up and down the walls of the rectum, rendering it in part rigid and immovable. The process is not so progressive, will usually give a history of previous syphilis, and may yield in part to anti-syphilitic treatment.

Treatment of Carcinoma of the Rectum.—Carcinoma of the lower edge of the rectum, or rather of the anus, occurs usually as an epithelioma

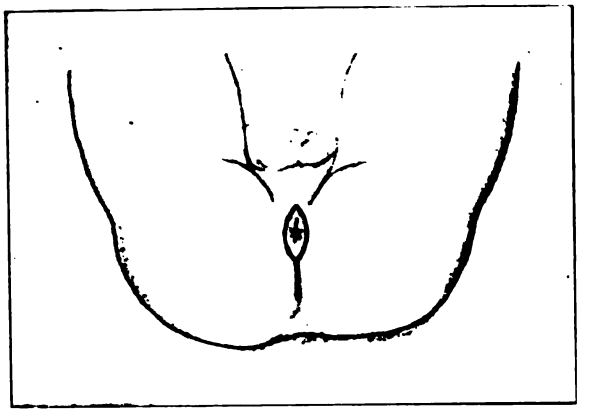


Fig. 265.—Incision for perineal proctectomy.

and requires excision, which may be carried out through the perineum. Two curvilinear incisions are made to surround the anus at about an inch from the border of the tumor. The incisions should go into the ischio-rectal fossæ, and may be extended down to the region of the coccyx if additional room is needed. The anus is separated from the adjacent tissues, being careful not to wound the membranous portion of the urethra or prostate in men, and the vagina in women. Going well above the diseased tissues, the rectum is cut across and removed; the lower end of the rectum is then brought down to the cutaneous incision where it is stitched to the wound.

In carcinoma of the lower portion of the rectum, the patient is placed on his left side and an incision is made from near the anus upwards, along

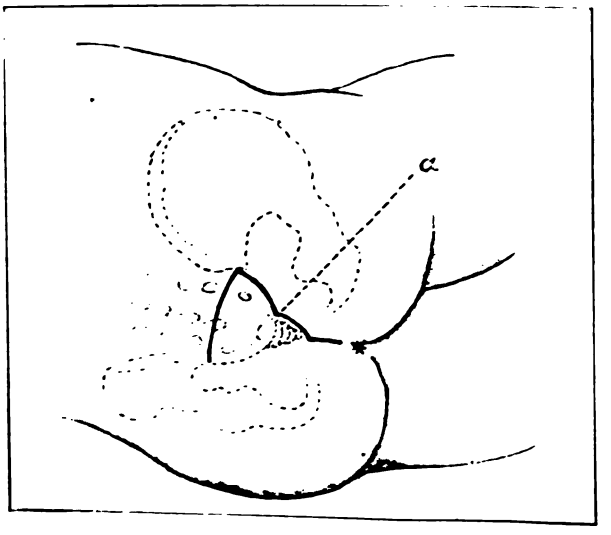


Fig. 266.—Showing Kraske's modified inc[illegible]

the right border of the coccyx to the sacrum. The incision is carefully deepened through the perineum until the gut is reached, when the diseased portion is separated from the adjacent structures, care being taken not to open the peritoneum, tear the rectum, or in men, wound the prostate, seminal vesicles or bladder. The diseased portion being isolated is then divided about one inch above and below the limits of the disease, and removed. The cut end of the rectum is then brought down and united with silk sutures to the distal portion, or, if this has been removed, to the skin. The incision is partially closed by suture and partially packed. (Figs. 265 and 266.)

In carcinomata of the rectum high up, many operators are doing a combined operation. The abdomen is opened, the upper limits of the growth defined, the bowel divided well above this, and an artificial anus established. The superior hæmorrhoidal artery is ligated and the mesentery of the distal portion divided. The abdomen is then closed and the rectum removed through a perineal incision.

CHAPTER XIII.

ORTHOPEDIC SURGERY.

Orthopedic surgery treats of deformities and their correction by operative measures, or the application of mechanical appliances.

TORTICOLLIS OR WRY NECK.

ETIOLOGY.—Torticollis may be congenital or acquired. The congenital cases may be associated with other deformities, such as club-foot or curvature of the spine. In these cases the condition has been ascribed to, (1) abnormal pressure of the uterus, (2) inflammation of the muscles, (3) arrest of development of the muscles due to disturbances in the nerves or in the nerve centers, (4) difficult labor, including injury to the muscles of the neck.

Acquired Torticollis may be due (1) to cicatricial contraction of the skin and deeper tissues from burns, (2) traumatisms of the neck causing injury of the muscles, with subsequent contraction, (3) inflammation of muscles as in rheumatism or in the acute infectious diseases, (4) the process may be reflex and due to the irritation of some pathological process going on in the neck, such as an abscess or enlarged lymphatic gland.

Compensatory torticollis occurs in lateral curvature of the spine. It may also be due to certain occupations which require the head to be held constantly in an abnormal position.

Spastic torticollis is due to nerve irritation, and this may be central or peripheral, tonic or clonic.

Torticollis may be due to paralysis of the opposing muscles.

PATHOLOGY.—In torticollis there is usually contraction or shortening of the sterno-cleido-mastoid muscle. This muscle may be alone implicated, when the condition is known as anterior torticollis, or the trapezius, platysma, scalenie and splenii muscles may be implicated, producing what is known as posterior torticollis. The affected muscles are not infrequently in a state of chronic inflammation. The muscular elements may disappear, fibrous tissue taking their place. In the operations which I have done for torticollis, the muscles have seemed quite normal in appearance.

SYMPTOMS.—Torticollis may be acute, as sometimes occurs in rheumatism, when the onset is sudden and attended with fever and pain; or chronic. The chronic form usually comes on gradually. It may develop from the acute, the congenital, or make its appearance without assignable cause.

The position assumed by the head varies according to the muscles affected. If the sterno-cleido-mastoid muscle is alone implicated, which is frequently the case, the mastoid process upon the affected side is made to

approximate the sternum. This carries the face in the opposite direction, elevates the chin and depresses the occiput. In case the trapezius and its associated muscles are markedly contracted, the head and corresponding shoulder are approximated, the head being drawn down and the shoulder up. The face in these cases is necessarily turned in the opposite direction.

DIAGNOSIS.—This ordinarily is readily made. The head is twisted to one side, cannot be brought straight with the shoulders and trunk, while one or more muscles in the neck are prominent and shortened. The appearance, however, will depend largely upon the muscles implicated.

PROGNOSIS.—This is ordinarily good. In the acute cases the inflammation of the muscles soon subsides and the muscles take on their normal function. The chronic cases are usually permanent unless relieved by surgical treatment.

TREATMENT.—In case the sterno-cleido-mastoid muscle is alone implicated, it is usually divided by open incision at its attachment to the sternum and clavicle. The muscle is exposed by a short incision just above the sternal end of the clavicle and the attachments of the muscle to the sternum and clavicle completely divided down to the deep fascia. The muscle is only separated from the internal jugular vein by the deep fascia, and this vessel has been wounded in a number of cases, and in some the accident has led to the patient's death. It is necessary in order to fully correct the condition to divide the muscle completely. The deeper portion of the muscle is separated from the internal jugular vein by only the deep fascia; this makes it advisable to do the operation by the open method, so that one can see just exactly what tissues are being divided. After complete division of the muscle the wound is closed, a catgut drain being inserted. The wound is properly covered with dressing and the head placed in an over-corrected position, that is the face, if the right muscle has been operated on, is turned strongly to the right, with the occiput elevated and the chin slightly depressed. The head and neck are held in these positions by bandages which go about the head, neck, shoulders and upper part of the chest. In cases in which there has been marked chronic myositis, with conversion of the muscle into fibrous tissue, it may be necessary to make an incision along the anterior border of the muscle, or fibrous tissue, and resect it.

In cases of posterior torticollis, portions of the implicated muscle, such as the platysma, and the anterior border of the trapezius, may be divided, or the spinal accessory nerve which supplies the trapezius may be divided just as it passes through the sterno-cleido-mastoid muscle.

In the after-treatment in either case the child's head should be kept in the over-corrected position for at least two or three weeks, and thereafter the child should be instructed to freely and fully move the head in the over-corrected position.

CONTRACTIONS OF THE PALMAR FASCIA—DUPUYTREN'S CONTRACTION.

This is a contraction of some portion of the palmar fascia, producing permanent flexion of fingers, usually the ring and little fingers.

CAUSES.—These are supposed to be traumatisms, irritations, gout and rheumatism. Atrophy of the adipose tissue in elderly people is said to favor. The condition begins as a small node beneath the skin of the palm, with

the contraction of the little or ring fingers. The contraction is usually progressive. The node commencing near the metacarpo-phalangeal joint increases to a firm fibrous band or cord which extends to the side of the fingers. At the same time the fingers are permanently drawn down until their tips touch the palm of the hand. The fingers cannot be extended.

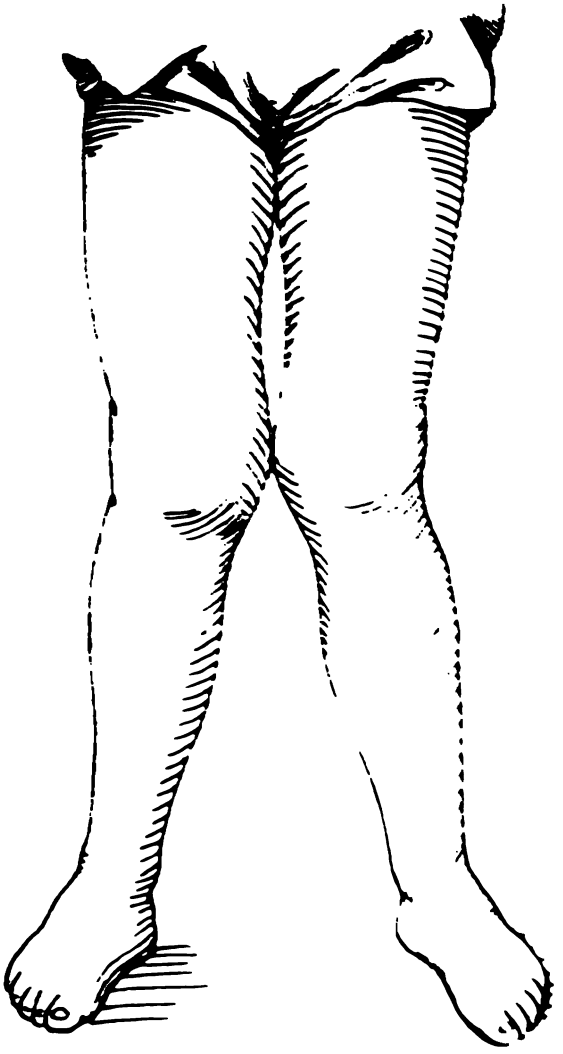


Fig. [illegible]

Diagnosis.—This [illegible] bral or spinal disease, with [illegible] the condition grows worse.

Treatment.—If the node is attached to the skin [illegible] the skin implicated with the node should be excised by two [illegible] incisions.

bones, and gives support to the internal lateral ligaments and stretches the external lateral ligaments. It also tends to atrophy (by changing the support) the internal condyle, which is usually excessively elongated, and excites the external to increased growth.

Operative treatment is indicated in severe cases which cannot readily be corrected by splints, and especially in severe cases which first come under treatment after ossification of the epiphyses has occurred.

The operative treatment consists in making a section of the femur above the condyle (osteotomy), or a section of the tibia and fibula below the knee.

Fig. 268.—Genu varum, or bow leg.

Usually the femur is the bone divided.

The internal surface of the femur is rendered aseptic, and an incision an inch long made through the skin and superficial fascia just above the condyle. The deeper fascia is separated down to the bone, when a narrow, sharp chisel is introduced to the bone, turned crosswise and made to divide two-thirds of the bone by a few sharp raps from the mallet. The remaining third of the femur is then carefully fractured off by adducting the femur above the incision by carrying the leg and knee straight inward. The limb

is then brought into a straight position, the wound covered with proper dressings and the limb bandaged to a long external splint. After a week or ten days this may be changed for a plaster of Paris cast. The patient should have the limb immobilized for from six to eight weeks and be kept off the foot for at least ten or eleven weeks.

GENU VARUM OR BOW-LEGS.

This is the opposite of genu valgum, or knock-knees. It is a deformity usually affecting both legs, but often to an unequal degree. The condition is seen more especially in young children, and is due to a rachitic state of the bones, muscular contractions and the weight of the body. If a line is drawn from the head of the femur to the internal malleolus, it will pass several inches internally to the knee joint. The tibia or femur (more often the former), is markedly twisted or even bent to an obtuse angle. The

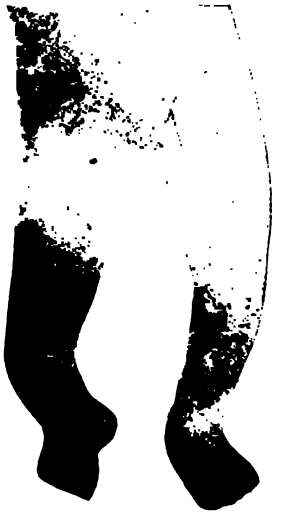


Fig. 269.—Bow legs. Little girl of four years.

condition is readily recognized by the deformity, the awkward, difficult and waddling gait of the child (Fig. 268).

TREATMENT.—As in knock-knee, spontaneous correction occurs to a considerable degree before puberty in a large number of cases.

The medical treatment consists in the improvement of the food and hygienic surroundings and in the administration of phosphates and tonics, as well as in the keeping of the child as much as possible off his feet.

The mechanical treatment consists in applying braces to the internal surface of the legs, with a pad over the internal surface of the knees, by which the legs are supported and the knees drawn into their proper position. If the bones are hard, and especially if the epiphyses are ossified, an osteotomy of the tibia and possibly of the fibula, with forcible correction of the deformity, will usually be necessary.

TALIPES OR CLUB-FOOT.

This is a congenital deformity in which the foot deviates from the normal in one or more of four directions. When the foot is over-extended the condition is known as talipes equinus; when flexed, talipes calcaneus; when adducted, talipes varus; and when abducted, talipes valgus. All these variations frequently occur in the same case, (Fig. 270, as a combination of equinus and varus—talipes equino-varus). In this, which is the most frequent deformity, the foot is extended and adducted, the sole turned inward, the child walking on the outer side of the foot and ankle.

Club-foot may also be acquired, as in infantile paralysis, in which a certain group of muscles, as those supplied by the external popliteal, are paralized.

Fig. 270.—Talipes equino-varus.

In a certain portion the congenital cases are said to be due to heredity. The condition has also been supposed to be due to the marriage of kin. The theories which have been most frequently advanced ascribe the deformity to intra-uterine pressure, or to paralysis of a certain group of muscles before birth. The malformation may also depend upon the arrest of development.

ANATOMY.—In talipes equino-varus the anterior portion of the foot is dislocated and twisted inwards at the medial tarsal joint. The scaphoid in these cases articulates with the side of the head of the astragalus, rather than with its anterior extremity; and in extremely aggravated cases the scaphoid may articulate even with the internal malleolus. Not only is the scaphoid displaced but also the cuneiform bone, the cuboid and the meta-

tarsal bones. In consequence of this displacement the sole of the foot is turned inwards and often upwards, the child walking upon the outside of the dorsum of the foot. The os calcis, cuboid, astragalus and scaphoid are not only changed in position but also in shape. The os calcis is located so that its anterior extremity looks outwards, while it is drawn from a horizontal to a partially vertical position. The anterior portion of the astragalus is depressed so that only the posterior portion of the articulating surface comes in contact with the articulating surface of the tibia. The cuneiform, cuboid and metatarsal bones are all twisted inwards, although not all to the same degree. Callosities and bursæ appear upon the outside of the dorsum of the foot, as the result of the abnormal pressure. Adults in walking have a very characteristic gait, in that they lift one foot over the other in a most awkward manner.

DIAGNOSIS.—This is made simply on inspection.

PROGNOSIS.—There is no tendency for this condition to correct itself naturally. In fact the deformity becomes more fixed and even aggravated in consequence of walking and the lapse of time.

TREATMENT.—This may be considered under the headings of mechanical and operative. In cases of congenital club-foot, the nurse and mother under the direction of the physician should be instructed to mold and manipulate the foot each day, so as to bring it as nearly as possible into its normal position. Although this method of treatment is always to be recommended, it very seldom succeeds in accomplishing a cure of the condition. In cases of aggravated club-foot, there should be a combination of the operative and mechanical treatment. In a case of pronounced talipes equino-varus, the tendo Achilles, plantar fascia and the tendons of the tibialis anticus and posticus, and perhaps the ligament of the scapho-astragaloid joint are each and all more or less shortened and contracted. These structures should be divided if possible before the child commences to walk, or about this time, because the weight of the body is a great factor in forcing the foot still farther out of position; while after correction, this weight assists in correcting the deformity and aids very materially in developing the muscles.

In the operative treatment the child should be anæsthetized and the anterior part of the foot grasped with the left hand and an attempt made as if to correct the deformity. This puts all of the structures on a stretch, when the tendon of the tibialis anticus muscle, as it crosses the instep, can be defined and divided subcutaneously. Care must be taken not to wound the dorsalis pedis artery. The tendon of the tibialis posticus passes immediately behind the internal malleolus. It may be divided in this situation by making a puncture just behind and above the posterior tip of the malleolus, and then passing a blunt tenotome into the wound and behind and under the tendon, when the cutting edge is turned toward the tendon and the tendon divided. This tendon may also be divided in the sole of the foot just before its insertion into the scaphoid and internal cuneiform bones.

The contraction of the plantar fascia is one of the most important factors in the maintenance of talipes equino-varus. This fascia is divided by seizing the front of the foot and making forcible extension, when the fascia is put strongly upon the stretch. A slight puncture is then made at its internal border, just in front of the heel, and a blunt tenotome passed through

this puncture and between the skin and the fascia. The knife is then turned with its cutting edge against the fascia and by a sawing motion the fascia is thoroughly and completely divided. Complete division here is necessary in order to obtain a good result. The giving way of the fascia can be readily felt and heard as the knife is pressed strongly upon it.

The division of the tendo Achilles should always be left to the last, because one has a better control of the foot in dividing the other tendons and

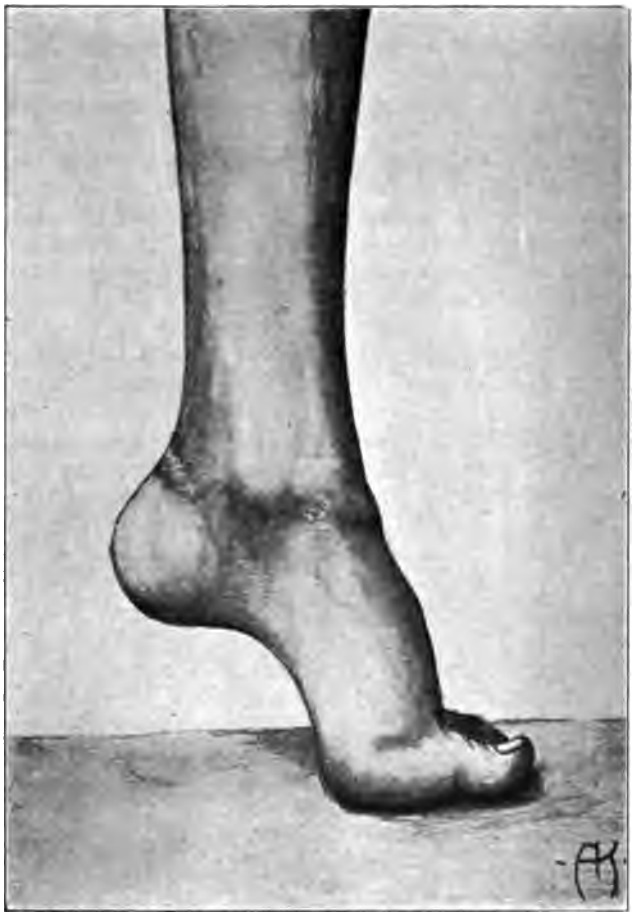


Fig. 271.—Talipes-equinus.

the plantar fascia. When dividing this tendon, the foot is strongly flexed so as to put the tendon upon the stretch. With a sharp-pointed bistoury a puncture is made through the skin just at the border of the tendon, and then a blunt-pointed tenotome introduced flatwise between the skin and tendon, and its cutting edge turned towards the tendon, and with a sawing motion the tendon divided. The blood should be pressed out of the various

wounds, which are then covered with absorbent cotton or sterilized gauze wrung out of an antiseptic solution. The foot is enveloped in gauze, cotton and a bandage. An effort should now be made to over-correct the deformity, and the varus deformity is first corrected, the anterior portion of the foot being carried strongly outward or in abduction, and the sole of the foot rotated outwards and upwards. If the varus deformity can be over-corrected then the foot is carried in a state of flexion to a right angle, correcting the equinus deformity. In this position of over-correction a plaster-of-Paris cast is applied, enveloping the foot and leg. Care must be taken in making the over-correction and in applying the plaster cast, not to produce such extreme pressure upon some part of the foot as to render it avascular and produce necrosis of tissue. To prevent this occurrence, which may happen, the toes should be left uncovered and their color watched for a few hours, and if the [illegible] anaemic and this whiteness does not give place to a normal [illegible] the cast should be slit down sufficiently to allow the [illegible] re-established. Ordinarily the plaster cast is left on for [illegible] it is removed, the foot and limb thoroughly [illegible] bismuth powder, enveloped in gauze cotton and a [illegible] again over-corrected, which is now comparatively [illegible] plaster-of-Paris cast applied. Under ordinary [illegible] plaster-of-Paris cast should be continued for six months [illegible] during this time to be as much [illegible] are removed and if the position of the foot [illegible] may put on ordinary shoes. If there [illegible] the deformity, retention shoes should be applied [illegible] a return has entirely disappeared.

TALIPES EQUINUS.

This is a position in which the foot is held in marked extension, or, as it is [illegible] called plantar flexion. In cases in which the deformity is only slight the foot can be flexed perhaps to a right angle. In cases of extreme equinus the foot cannot be flexed at all. The condition is rare as a congenital affection, but does occur. As an acquired deformity it is frequent. It may be due to infantile paralysis (anterior poliomyelitis), to cerebral paralysis, disease of the ankle joints, to shortening of the leg, and to long confinement to bed.

DIAGNOSIS. The diagnosis is made by inspection, and considering the cause. (Fig. 271.)

TREATMENT. In the milder cases of acquired talipes equinus the cause should be sought for and if possible corrected. If the tendon and the plantar fascia are at fault, these structures should be divided, the deformity corrected, and a retentive apparatus if necessary worn. If due to infantile paralysis in which the external popliteal nerve is at fault, and the case recent, the greatest benefit may result by dividing the external popliteal nerve in the popliteal space and anastomosing it to the internal popliteal. This anastomosis re-establishes the nerve influence to the paralyzed muscles, and as a rule is of the greatest benefit to the individual. In other cases great benefit is derived from anastomosing the functionating muscles into those

which are paralyzed. In other cases the requirement may be met by the application of a retention or traction apparatus.

TALIPES CALCANEUS.

In this deformity the foot is held in dorsal flexion.

This condition may be combined with talipes valgus. It is most frequent as an acquired deformity, although it may be congenital. In the acquired condition it is most often due to anterior poliomyelitis (Fig. 272).

DIAGNOSIS.—The diagnosis is made on inspection.

Fig. 272.—Talipes calcaneus.

TREATMENT.—In the congenital cases manipulation in which the position of the foot is over-corrected will often be sufficient. A retentive shoe may be necessary in some cases, or the tendons may be anastomosed.

TALIPES VALGUS OR FLAT-FOOT.

This deformity is characterized by eversion of the foot (or pronation) and abduction. The affection is either congenital or acquired. In the congenital cases the condition is usually not pronounced. The acquired form

is frequent and often due to rickets, weakness of the muscles, and the weight of the body, in consequence of the child's being much on its feet. It may also be due to accident, or to a diseased condition of the limb.

PATHOLOGY.—The normal foot, on standing, rolls inwards slightly. The fore part of the foot is abducted and the internal malleolus lowered. In the weak foot these movements are exaggerated. The arch of the sole is obliterated, the internal malleolus becomes prominent, and approaches the floor. The foot is strongly everted and abducted. The form of the bones is but

Fig. 273.—Talipes valgus, or flat-foot.

little altered, but the relations are changed. The astragalus is turned to one side and its articulating surface looks inwards towards the internal malleolus. The scaphoid is carried outward with the foot and its anterior border raised. The calcaneo-scaphoid and the calcaneo-astragaloid ligaments are stretched, allowing the arch of the foot to fall. In consequence of these changes the motions of the foot are limited (Fig. 273).

SYMPTOMS.—The normal arch of the foot is gone, while the internal border rests upon the floor. The foot seems long and broad and is everted.

The head of the astragalus and the scaphoid are prominent. In extreme cases the deformity cannot be approximately corrected without severe pain. The astragalo-scaphoid articulation, a point in front of the internal malleolus, and a third point in the sole of the foot in front of the heel and at the head of the os calcis, are very painful. The feet often prespire freely and the patient tires quickly on walking. He suffers much pain and the feet and limbs are often swollen.

The diagnosis is made by inspection.

PROGNOSIS.—As a rule the condition increases without treatment, and walking becomes gradually more and more difficult and painful.

TREATMENT.—In instituting treatment one must remember that there are two conditions to be overcome, eversion and abduction. In cases which

Fig. 274.—Pes cavus.

are marked the patient is anæsthetized and the foot over-corrected by manual force, that is, the foot is carried into strong adduction and the sole rotated inwards. While in this position plaster of Paris bandages are applied. These should form a cast of sufficient firmness to allow the patient to walk without breaking the plaster. After two or three months the plaster may be changed, and when the pain and tenderness have disappeared a retentive shoe may be substituted, if this seems necessary. The results of the treatment are usually satisfactory.

PES CAVUS.

In this deformity the arch of the foot is exaggerated in consequence of the anterior portion being drawn backwards toward the heel. The con-

dition is ascribed to one of three causes: first, the contraction of the peroneus longus muscle; second, to paralysis of the gastrocnemius and soleus muscles in consequence of which the long flexors draw the anterior portion of the foot backwards; and third, to paralysis of the interosseus and lumbrical muscles. In the latter the heads of the metacarpal bones are depressed, the first phalanges extended and the second flexed (Fig. 274).

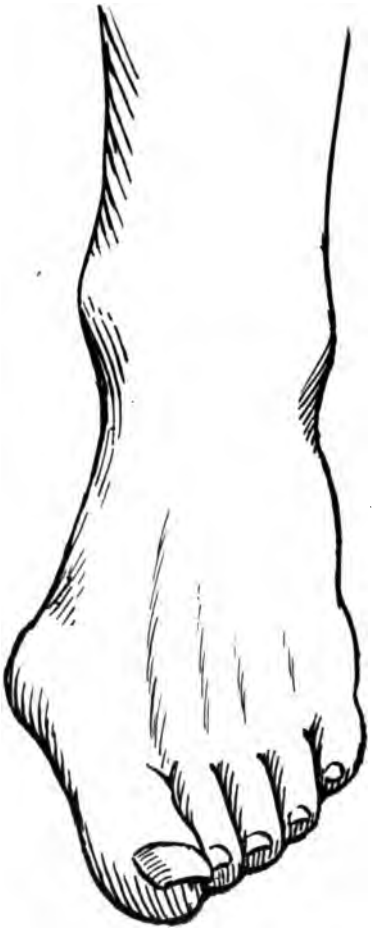


Fig. 275.—Hallux valgus.

TREATMENT.—This usually consists in the application of a steel sole to the shoe, which is bound by straps over the instep, for the purpose of straightening the foot. In the first form, that due to contraction of the peroneus longus, the tendon of this muscle may readily be divided.

HALLUX VALGUS.

This is an outward displacement of the great toe, the long axis of which in the normal condition passes through the heel. In this condition it passes

inward anterior to the instep. The condition is usually caused by wearing pointed, narrow, or too short shoes.

PATHOLOGY.—The heads of the bones at the metatarso-phalangeal joints are usually markedly enlarged in consequence of periosteal irritation. At the same time the sesamoid bones may be pronouncedly thickened. The big toe is pushed inwards, making the head of the metatarsal bone very prominent. Frequently there is a thickened and often inflamed bursa directly over the head of the metatarsal bone. This bursa often becomes infected and suppurates (Fig. 275).

SYMPTOMS.—The gait lacks elasticity and the patient limps. There is

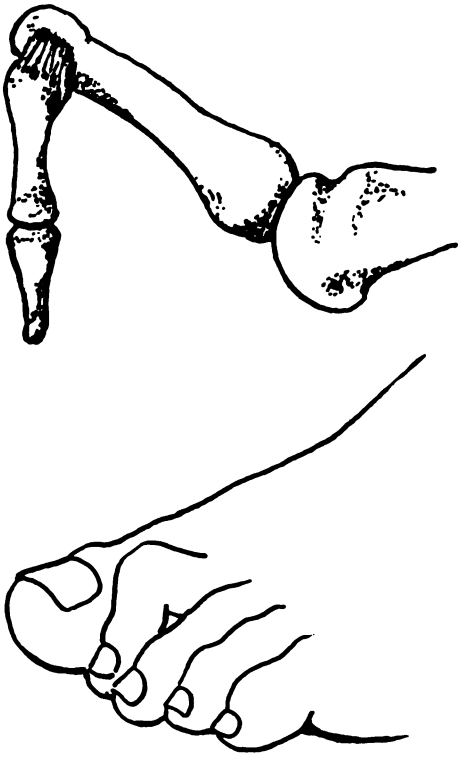


Fig. 276.—Hammer toe.

considerable pain. The condition is usually attributed to gout and rheumatism and is not infrequently aggravated by these diseases.

TREATMENT.—A long wide shoe with a thick sole to give support to the bottom of the foot, should be worn. If this does not give relief a splint made of hard rubber may be bound to the inside of the foot and the toe bandaged to this splint, dragging it inward to its normal position. Ordinarily in cases which are at all aggravated, resection of the joint will be found necessary. This removes the enlarged ends of the bones, with any sesamoid bones that may exist, gets rid of the enlargement, shortens the toe somewhat, and brings it back into its normal position.

HAMMER-TOE.

In this condition there is a contraction of the second and third phalanges of a toe or toes. The first phalanx is usually extended and the third may be, or the second and third may both be contracted. The toes most frequently affected are the little and second toe. The cause may be the wearing of tight and narrow shoes, in consequence of which the toes are crowded together and one or more forced downward beneath the other toes. In this condition walking is often painful, the depressed toe becoming very sensitive and callous (Fig. 276).

TREATMENT.—In mild cases a strip of adhesive plaster may be carried under the offending member and over the adjacent toes, for the purpose of pulling it upwards into place; or a plantar splint may be bound to the foot. The shoe should be long and have a wide and thick sole. In severer cases the flexor tendons may be divided, the joint resected, or the toe amputated.

RICKETS.

This is an affection occurring usually in infancy, somewhere between the sixth month and the end of the third year. Rickets is a disease which affects very largely the long bones and is characterized by a failure of deposit of lime salts at the epiphyseal junctions, and an absorption of the salts which have already been deposited. The condition may be hereditary or acquired.

ETIOLOGY. The disease is seen chiefly among poor children in the crowded districts of our large cities. It is seemingly caused by a combination of circumstances, such as unhygienic conditions, including bad air, damp and overcrowded dwellings, and want of sunlight. Rickets is seemingly at times inherited; a woman that is subjected to hardships, forced to labor excessively, and deprived of proper nourishment, often brings forth rickety children. Perhaps the most important factor in the causation of rickets is an improper diet. It has long been held that if a child was deprived of its mother's milk and fed largely upon farinaceous food, it would be predisposed to rickets, and this is probably true. It has recently been suggested that rickets was due to a deficiency of fat and proteids in the food. This is what a child that was brought up on farinaceous foods would fail to receive. It has also been held that lactic acid is generated in excess in the intestinal canal by the fermentation and imperfect digestion of starchy food, and that this acid unites with and removes the lime salts of the bones.

SYMPTOMS. The ordinary clinical manifestations of rickets are restlessness at night, profuse perspiration, especially about the head, neck and shoulders, constipation alternating with diarrhœa, enlarged abdomen, weakness of the limbs and a whitish or putty condition of the skin. The head is often increased in size and the fontanelles are late in closing. Dentition is usually delayed. Pigeon breast is frequent in consequence of the softening of the ribs. The sternum and anterior portion of the chest becomes forced outwards, increasing the chest antero-posteriorly and diminishing it transversely. Bronchitis is also frequent.

PATHOLOGY.—At the epiphyseal junction of the bones the zone of cartilage cells proliferates unduly, causing this area to be much broader than normally, while the zone of calcification is irregular and often indicated by

scattered whitish spots. The marrow is hyperæmic and vesicular, medullary areas penetrating the soft cartilage. Between the cartilage and bone there is often a layer of osteoid tissue. Vascular medullary sprouts are to be noticed in the uncalcified cartilage, often surrounded by adenoid tissue. The periosteum produces a soft, osteoid tissue which surrounds the ends of the bone like a ferule; or this osteoid tissue may appear in circumscribed areas and produce outgrowths like osteophytes. In consequence of these changes the long bones become softened, bent and often very much twisted upon themselves. The process is most frequently noticed in the tibia, fibula and femur, although the epiphyseal thickening is often found at the end of the radius and ulna. The child seems short and often stunted in its growth (Fig. 269).

PROGNOSIS.—This is ordinarily favorable. Often at or about puberty the softened bones become rapidly calcified and much of the bending and twisting is corrected.

TREATMENT.—Unhygienic surroundings should be corrected if possible, and the child placed in apartments which are well lighted, thoroughly ventilated and supplied with fresh air. Children suffering from rickets should be kept in the fresh air as much as possible, but off of their feet the major portion of the time. They should be given a diet containing animal foot, such as fresh milk and meat juices, and if of sufficient age, eggs and meat. Codliver oil and the hypophosphites are, as a rule, very serviceable in the treatment of these cases.

POTT'S DISEASE.

KYPHOSIS. ANGULAR CURVATURE. TUBERCULOSIS OF THE SPINE.

This is a distinctive pathological process, confined to the spinal vertebræ.

HISTORY.—Anterio-posterior curvature of the spine was known to the ancients. Galen and Hippocrates attributed the disease to tuberculosis of the vertebræ. Ambrose Paré treated the disease with a metal cuirass. Percival Pott accurately described the disease in 1779, since which time it has been known by his name.

PATHOLOGICAL ANATOMY.—The bacilli of tuberculosis become implanted in the cancellous structure of the bone, causing the formation of tubercles and granulation tissue, with more or less destruction of the bone structure. The process takes practically the same course as tubercular processes in the cancellous structure of the long bones. In consequence of this destruction of bone and the superincumbent weight of the body, the implicated vertebræ become crushed together, producing an angular curvature. The tubercular masses may caseate and form pus. Even after the formation of pus the process may become arrested, the pus inspissated or absorbed, and healing occur. In very many cases, however, the disease is progressive and a large abscess forms, which may become prominent in the lumbar region beneath or above Poupart's ligament, in the back between the ribs, in the pharynx, or in the gluteal region.

The disease, with few exceptions, occurs in infancy or in young adult life

[illegible] the dorsal or lower [illegible] are also not [illegible]

[illegible] the arrest of the bacilli [illegible] The predispos- [illegible] and frequently [illegible]

[illegible] stiffness of the spine, [illegible] muscles. Asso- [illegible] the spine [illegible] which is always ag- [illegible] The pain experienced is not in [illegible] which take origin [illegible] chest, abdomen [illegible] the patient is often charac- [illegible] in character. If [illegible] elevated and [illegible] the superincumbent weight [illegible] the vertebræ from [illegible] is abnormally [illegible] the shoulders are ele- [illegible] are thrown [illegible] shuffles [illegible] disease [illegible] the superincumbent weight of [illegible] If the child is near a [illegible] upon this [illegible] its hands [illegible] shoulders from the [illegible] and thus get [illegible]

[illegible] cartilages, the child [illegible] pains. As the [illegible] have been in a state [illegible] makes an inad- [illegible] the inflamed [illegible] a scream. This [illegible] becomes com- [illegible]

[illegible] posterior angular [illegible] This deformity is ag- [illegible] upon the shoulders. [illegible] shoulders. The de- [illegible] vertebræ. Its [illegible] vertebræ and the [illegible] of the disease [illegible] the result of treatment. [illegible] deformity is at all marked, [illegible] consequence [illegible] tening and bow-

ing of the spinal column. In Pott's disease there is practically always a rise in temperature during the afternoon and evening, of from one to three degrees Fahrenheit. The child becomes weak and anæmic, with loss of appetite and flesh.

The most frequent complication is the formation of an abscess. In cases which early receive proper treatment, the course is often run without this complication. The formation of an abscess is due to the same causes that lead to the formation of tubercular pus in other locations; and these usually are a weakened condition of the system, want of resistance, absence of immobilization of the spine, with pronounced bacillary infection. The advent of pus formation is often attended with an increase of the fever.

In the cervical region the abscess may make its appearance in the pharynx, behind the sterno-cleido-mastoid muscle, or may make its way into the anterior mediastinum. In the dorsal region the pus most frequently reaches the sheath of the psoas muscle, and produces a swelling in the iliac fossa, beneath or above Poupart's ligament; or in the lumbar region. In lumbar abscess the pus may reach the psoas muscle and become prominent above or below Poupart's ligament, or in the lumber or gluteal region. Psoas abscess in Pott's disease is by far the most frequent serious complication.

Marked weakness, paresis or paralysis of the legs is a common complication in Pott's disease. The disturbance is first of motion and later of sensation. The limbs become wasted and the muscles flaccid. The loss of function in the legs, unless complete, is seldom uniform, one leg being more severely affected than the other.

DIAGNOSIS.—In cases that are at all advanced the gait, attitude and general appearance of the child are so characteristic and peculiar as to render the diagnosis easy. In commencing cases the history is not sufficient, and in all cases a careful physical examination should be made. In conducting the examination the child should be handled with the greatest care, if possible gaining its confidence, so that one may acquire the greatest amount of information from the manipulations which are necessary. The child should be stripped, and if there are any deviations of the spine from the normal, these are to be noted. The most characteristic symptom of tuberculosis of the spine is the angular curvature. One or more of the spinous processes are found to project, at least in advanced cases, quite markedly backward, producing a more or less sharp angle. The posterior projection may implicate but one or two spinous processes, or several. The spine is examined for muscular rigidity and its lateral and antero-posterior flexibility demonstrated. The normal spine is very flexible and can be bent laterally and antero-posteriorly to a very marked degree, as well as rotated. The neck can readily be bent forward and backwards and if the child is lying on its face the feet can be carried upwards, so that the limbs will make almost a right angle to the lower or lumbar spine. In tuberculosis of the vertebræ the affected region is thickened and rigid, and any attempt to move it laterally or anterio-posteriorly, or by rotation, will be resisted, and if persevered in will cause severe pain. The erector spinæ muscles are usually in a state of tension.

A child with angular curvature of the spine stoops when about to pick thing from the floor, in a manner which is peculiar and characteristic.

The spine is kept perfectly rigid. The child flexes the thighs on the abdomen, and the legs upon the thighs, in other words, sits down upon its feet, and with the arm falling along the side of the chest and abdomen, endeavors to secure the desired object, without moving the spine. The child's attitude in walking is also usually characteristic, in that the head and spine are held rigid, and the child shuffles cautiously along upon the anterior portion of his feet, scarcely touching the heels to the floor. Then the child's attitude, as stated, in constantly seeking some point for support in order to raise the superincumbent weight of the head and shoulders from the diseased vertebræ, is extremely characteristic. The child in standing, if the process is in

Fig. 277.—Angular curvature of the spine. Position of child's hands characteristic.

the advancing stage, will always, if possible, place its hands upon some article of furniture or upon its knees, in order to transmit the weight of the head and shoulders through the arms to the thighs, or through the arms to some article of furniture, and thus relieve the diseased vertebræ. (Fig. 277.)

Prognosis.—Pott's disease of the spine is very serious and its prognosis, as a rule, bad. The majority of the cases succumb sooner or later to general tubercular infection. In other cases the process becomes arrested and the patients reach old age.

Treatment.—In progressive cases and in the early stages of all cases, the patient should be put to bed for a few weeks and have the spine im-

mobilized. This may be accomplished by strapping the child to a gas-pipe frame (Fig. 278), and making pressure posteriorly at the sides of the angle; or if the disease is situated in the lower dorsal or upper lumbar region, a plaster of Paris cast may be applied. Aside from immobilization and rest the patient should be kept in the open air and sunshine as much as possible, and if confined to the house at night, the windows must be kept open. In addition to this the diet is of great importance. The patient should be encouraged to take as much as possible of fresh milk, eggs, and the juices of meat. Fresh air, sunlight and good food are factors which are indispensable and must be supplied, if the greatest good is to be derived from the treatment. Extension in these cases from the head or feet is seldom necessary, unless the child is seriously annoyed in consequence of the jumping pains which occur when it is trying to sleep. When the acute symptoms have disappeared the child may be allowed to get up, the spine being supported by a plaster cast, if the process is in the middle or lower dorsal or upper lumbar region, and by a cast and jury mast if it is in the cervical or upper dorsal region.

Abscess situated within the pharynx may be opened through the mouth or through the posterior cervical triangle. The latter situation is ordinarily preferred if the abscess can be readily reached, as the danger of suffocation from the discharge of pus is eliminated, and the area of infection and dis-

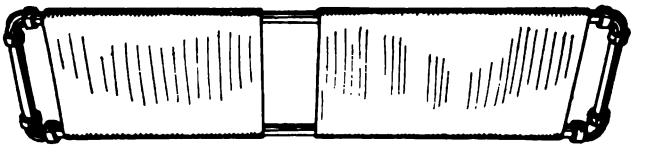


Fig. 278.—Bradford's frame.

case can be the better treated through the side of the neck than through the mouth. In psoas abscesses the treatment will depend something upon the situation of the pus. In cases in which the pus reaches Poupart's ligament it is ordinarily advisable to draw the fluid off through a canula and then inject six ounces of a 10 per cent. emulsion of iodoform in glycerin. As a rule, following this treatment, the abscess cavity will refill but slowly, then the injection may be repeated. The treatment is occasionally curative. In many of the cases in which the pus reaches the right iliac fossa or Poupart's ligament, or projects perhaps no further downwards than the lumbar region, an incision sooner or later will be required at the outer border of the erector spinæ muscles, extending from the twelfth rib to nearly the crest of the ilium, through which the abscess cavity can be reached and drained, and its lining of granulation tissue swabbed out. This may be done with a small sponge, cloth, or a pair of long forceps, by the finger and fingernail, or by a large dull curette. The disease may be found in a transverse process, more frequently in a lumber vertebra, and in some cases the diseased area can be removed by curette or a pair of cutting forceps. In many of these cases, after thoroughly opening the abscess, removing the granulation tissue lining, and possibly removing the diseased bone and establishing free drainage, washing the cavity out every day, and after the washing pouring in an ounce or more

of iodoform emulsion, the patients quite rapidly improve, and many of them make a complete recovery, the abscess cavity becoming wholly obliterated. In case the abscess opens between two ribs injections of iodoform emulsion may be practical, and if these do not succeed, one or more ribs may be resected and an attempt made to follow the fistulous tract, and establish thorough drainage, to remove the granulation tissue, and if possible to reach and remove the seat of disease.

Paralysis.—When one takes into consideration the cause of paralysis, it will give a clue to the proper treatment. Paralysis may be due to the angular curvature, the cord being pinched between the vertebra below and the laminæ of the vertebra above, as occurs in fracture of the spine; it may be due to the pressure of the inflammatory exudate, and is often due to the infection from the focus of disease extending to the membranes or the cord itself, and establishing a meningitis or a myelitis. In cases in which the paralysis is due to pressure in consequence of the angular curvature, resection of the laminæ is indicated, and at times proves brilliantly successful. In cases in which the paralysis is due to pressure in consequence of the inflammatory exudate, the same treatment is indicated. In cases in which there is a meningitis or a myelitis, rest, the application of cold to the spine, or counter irritants, with the internal administration of ergot or the bromides, are indicated.

Forcible Correction of the Angular Curvature.—Calot, of Berckscurmere, and Chipault, of Paris, recommended in 1893 forcible correction of the spinal deformity. This was done by supporting the child between two transverse supports, one placed near the hips and the other near the arm pits, and making forcible compression upon the angular projection. If sufficient force is used the deformity can be in a measure overcome. For obvious reasons this treatment has not come into general use. The dangers are very pronounced. Many of the children have died from shock, others from acute tubercular infection, and others again from hemorrhage. The treatment in a general way is scarcely to be recommended.

LATERAL CURVATURE OF THE SPINE. SCOLIOSIS OR ROTARY LATERAL CURVATURE.

Lateral curvature is usually acquired, though it may be congenital. It is said to occur in children in about one and one-third per cent. of all cases. Congenital lateral curvature is either the result of fetal rickets or of imperfect development. Lateral curvature of the spine occurs five times as often in girls as it does in boys.

The clinical history of lateral curvature has been divided into three stages: First, the initial stage; second, the stage of development; and third, the stage of arrest.

The initial stage has few symptoms and is seldom recognized. It occurs during early childhood, and is represented by a slight elevation of one shoulder, a prominence of the opposite hip, and a scarcely perceptible curvature of the spine. The spinal deviation disappears upon suspension or recumbency. The child suffers no inconvenience. A careful examination, however, during this stage will disclose rotation of the spine, prominent hip and elevated shoulder.

The stage of development includes the growing period up to maturity. The deformity may be slight or very pronounced. One shoulder and the opposite hip are prominent. There is muscular weakness with pains along the intercostal nerves upon the side of the concavity. The curves are usually flexible and largely disappear on suspension or recumbency. (Fig. 279.)

The stage of arrest usually dates from maturity. The curves are then usually fixed and only in part disappear upon suspension.

SYMPTOMS.—Pain is a frequent symptom and results from the muscular and ligamentous strain, and from compression of the intercostal nerves by the laminæ and ribs. The person is usually weak, anæmic, debilitated, tires read-

Fig. 279.—Lateral curvature of spine. Convex to right, left hip prominent.

ily and lacks energy. There is a lack of muscular tone and strength, shortness of breath on exertion, loss of appetite and difficult digestion.

It should be taken into consideration that lateral curvature of the spine is not a disease, but a condition in which the spinal column is curved and distorted. The deformity consists of two distinct conditions. One of these is a lateral curvature and the other a rotation of the vertebræ. The curvatures vary in degree, situation and extent. They are ordinarily spoken of as being primary and secondary, or compensatory. If a primary curve is situated in the middle region of the spine, short compensatory curves develop above and below the original curvature. These compensatory curves are necessary in order that the child may remain erect and keep his head in the

middle line. Occasionally a compensatory curve is long and equals in extent the primary curve.

A curvature situated in the cervical region is comparatively infrequent, except as a result of torticollis. The shoulder on the side of the convexity in cervical curvature is raised, and the arm falls away from the side. The opposite shoulder is depressed.

The most frequent dorsal curvature has its convexity to the right. In

Fig. 280.—Curvature of the spine with marked rotation, in a girl of 20.

these cases the right shoulder is raised and the right scapula prominent and carried backwards. The right side of the chest in front is flattened. The left shoulder is flattened and lowered, the left breast prominent and projects forward. The left side of the chest and left lumbar region are concave, and the left hip prominent. These deformities are largely the result of the rotation of the spine to the right.

In lumbar curvature the convexity is usually to the left. The right hip is then prominent, with a concavity in the right lumbar region. In severe

cases the curvature is so considerable that the pelvis is tilted, and one of the limbs seemingly shortened, causing the child to limp in walking.

In every case of curvature of the spine there is more or less of torsion or rotation. The degree of torsion is a measure of the severity of the case. To torsion is due the displacement of the ribs, the prominence of the shoulder and of the opposite breast, and the projection of the hip. The rotation of the spine is much greater than is apparent from a simple inspection of the back.

Fig. 281. Front view of Fig. 280

ETIOLOGY.—All are not agreed as to the causation of lateral curvature. The condition has been ascribed, first, to unequal muscular action. This is apparently of frequent occurrence in weakly and debilitated children. In order to maintain the spine erect, constant and equal muscular contraction must be maintained. If this fails in any group of muscles the spine will deviate with the convexity toward the side of the weakened muscles. This is

the theory of Eulenburg. Second, to an irregularity in the growth of the different portions of the vertebræ. Third, to the superincumbent weight of the body upon the weakened spine. This latter is the theory of Roser, Volkmann and others. Lateral curvature may also be due to torticollis, inequality in the lengths of the lower limbs, Pott's disease, sacro-iliac disease, rickets, paralysis, and the result of occupation in which the spine is held in an abnormal position.

PATHOLOGY.—In lateral curvature the bones are not altered by disease but changed in shape by pressure. This change occurs most markedly in the fixed stage. Whenever lateral curvature occurs the bones are crowded together and compressed on the concave side, while on the convex side they are separated. In consequence of this abnormal and long continued pressure, the vertebræ become, as it were, wedge-shaped, that is, thicker on the convex side and thinner on the concave side. The same condition holds true in regard to the inter-vertebral cartilages. The articulating surfaces also become changed, as well as the spinous processes. In consequence of exaggerated lateral curvature the shape of the chest becomes greatly altered, and the side upon which the convexity exists is very much reduced in its dimensions, while the dimensions of the corresponding side are increased. The viscera may be seriously pressed upon in consequence of this deformity, and the ribs upon the concave side are closely crowded together, obliterating the intercostal spaces and making undue pressure upon the nerves. The lower ribs upon the side of the concavity may rest upon the crest of the ilium, or press into the iliac fossa. In the rotation the bodies of the vertebræ are turned towards the convexity of the curve, the spinous processes toward the concavity.

DIAGNOSIS.—In severe cases this is readily made on examination. The patient should stand and have the back bare down to the crease between the buttocks. The tips of the spinous processes are then marked with an indelible pencil, as well as the tips of the scapula. A line, having a small weight at one extremity, as a tape measure, is dropped from the center of the occiput to the sacral region; the deviations from this line will represent the extent of the curvature. The distance from this line to the tips of the scapula should be taken, while the patient has his arms crossed in front of the chest. Any want of symmetry in the chest wall and of the scapulæ should be also noted. The flexibility of the spine in the lower dorsal and lumbar region may be determined by having the patient stand with a block or blocks of various thickness first beneath one foot and then the other, this without interfering with his resting upon both feet with the knees straight. The flexibility may also be tested by having the patient bend from side to side.

PROGNOSIS.—This will depend largely upon the general health of the patient, and his age. The younger the patient and the greater the debility and loss of muscular tone, the more likely is the condition to become marked. Lateral curvature of the spine usually progresses, if untreated, until the osseous system is fully developed and the patient reaches adult age. The deformity once occurring there is no tendency towards self-correction.

PREVENTION.—The patient should be taught to sit upright and never, as is too frequently the custom, sit on one foot. The seats at school should be of

proper height and give support to the back. The patient should also stand erect and on both feet.

TREATMENT.—In the treatment special attention should be given to the general health; anæmia, muscular debility and loss of tone, both muscular and nerve, should be corrected by the administration of tonics, by outdoor exercise, fresh air, massage to the muscles of the back, and especially by gymnastic exercise or Swedish movements. The use of dumbbells and the cross-bar are greatly to be recommended in this class of cases. In the use of a cross-bar, the hand on the concave side of the curvature should be always kept at a higher level than its neighbor. In lying down the patient

Fig. 282.—Congenital dislocation of right hip.

should select a flat, hard mattress, and beneath the projecting scapular region may be placed a flat, hard pillow. After the gymnastic exercises, and especially at midday, the patient should lie down upon the back for half an hour or more. Recumbency removes the superincumbent weight and assists very materially in toning up the weakened and tired muscles and in relieving or in preventing the increase of the curvature. The use of braces and plaster casts for the correction of lateral curvature are ordinaily not to be recommended. If the patient is seen early and the case properly treated by gymnastics, Swedish movements and dumbbell exercises, once or twice a day,

coupled with massage to the muscles of the back, and cold shower baths, and tonics, the deformity can be corrected in nearly every case, or if not corrected, at least prevented from becoming aggravated.

CONGENITAL DISLOCATION OF THE HIP.

This affection occurs about seven times as often with girls as with boys, and in about one-third of the cases the dislocation is double. (Fig. 282.)

Etiology.—Almost nothing is known as to the causative factors in the production of this dislocation. It is thought by many that the condition may be due to imperfect development of the acetabulum, and in a few cases the condition seems to be hereditary.

Pathology.—In the normal state the capsule which passes from the rim of the acetabulum to the intertrochanteric line simply encloses the neck of the femur like a tube. In congenital dislocation as a result of the weight of the body being borne by the capsule this becomes greatly stretched and elongated. The capsule is also drawn across the rim of the acetabulum and becomes adherent to it. The acetabulum in consequence of the absence of the head, becomes more or less filled with new tissue and consequently in part obliterated. The muscles in congenital dislocation are changed in length. Some are shortened, and especially the adductors, the psoas, iliacus and the hamstring muscles, while the obturator and gemelli are lengthened. The shortening of some of the muscles, the adherent and thickened capsule, and the filling of the acetabulum with new tissue, are the principal factors in opposing reduction. Unless the muscles are stretched or divided and some of the ligaments elongated reduction cannot be effected. In some of these cases in consequence of this malposition, the head of the femur is flattened and the neck twisted.

The positions of the head of the bone from the acetabulum are first, backwards, when the head lies upon the dorsum of the ilium; second, upwards and just above the acetabulum; and third, forwards where it lies close to the anterior spine of the ilium. If the head of the bone is just above the acetabulum the axis of the limb is not materially changed and the distortion of the spine is slight. If the head of the bone is upon the dorsum of the ilium, the axis of the limb is markedly changed and the deformity is great. This deformity consists in a lumbar arching forward of the spine, known as lordosis.

Symptoms.—Congenital dislocation at the hip does not attract attention until the child begins to walk, when in unilateral cases the gait is seen to be peculiar. While the child is standing the back is very much arched, and in walking, when putting the foot to the ground it suddenly seems to give, or become shortened, and the little patient lurches forward to get support on the sound leg. This produces a very characteristic rolling gait. In double dislocation there is a giving way on each side, with a rocking, waddling gait, and prominence of the trochanters. The child tires readily on walking. There is, however, no pain and the patient thrives and seems well.

Diagnosis.—This will depend on the position of the top of the great trochanter above Nélaton's line, and the further fact that the limb is excessively mobile and can be drawn down to nearly its normal length.

The condition must be differentiated from coxa vara, distortion following infantile paralysis, traumatic dislocation, deformity following arthritis of infancy, and the deformity of hip disease. In all of these affections, excepting coxa vara, there will be a history of previous injury or disease. In coxa vara, with distortion of the neck and shortening of the limbs due to rickets, the head of the bone is in the acetabulum. Coxa vara rarely becomes pronounced before the fifth year.

PROGNOSIS.—While congenital dislocation of the hip does not affect the general health, it produces a very distressing deformity and lameness, and the person tires readily in walking.

TREATMENT.—This may be considered under two heads, forcible reposition and open incision.

The method of reduction by force has been popularized by Lorenz. In this method it is first necessary, under an anæsthetic, to stretch or rupture the shortened muscles before reduction can be accomplished. The adductors are forcibly elongated or ruptured, by carrying the limb in strong abduction and making sudden and forcible pressure upon these over-tense muscles at their attachment to the pelvis. The hamstring muscles as well as those attached to the lesser trochanter are stretched by forcible extension and flexion. When these muscles have been sufficiently ruptured or elongated and the limb is quite free, reposition can usually be readily attained by traction upon the thigh at a right angle to the pelvis, while pressure is made by a wedge beneath the great trochanter. A distinct click is heard as the head of the bone slips into the acetabulum. With the limb held in a strongly abducted position a spica bandage of plaster of Paris is applied, including the thigh and pelvis. The child should wear the plaster jacket for from six to twelve months. It should, however, under ordinary conditions be removed every two or three months, the limb examined, thoroughly bathed and powdered, and the cast reapplied. With each application of the plaster cast the limb can be brought down from its strongly abducted position some 15 to 20 degrees.

The most suitable age for the reduction of congenital dislocation of the hip is from the second to the fifth year. After five years reduction is often very difficult, and especially when the dislocation is bilateral. The older the child and the more it has been upon its feet the more tense and resistant are the muscles, and consequently the greater injury done in accomplishing reduction.

Unilateral dislocation may be reduced up to the ninth or tenth year. Bilateral seldom later than the sixth or seventh year.

Risks of Forcible Reduction.—The femur or its neck may be fractured. Important blood vessels or nerves may be torn. The external popliteal has frequently been lacerated. The adductors in severe cases following rupture may only to a limited extent reattach themselves to the pelvis, leaving the limb weak and quite flaccid. At times there is almost complete paralysis following the use of excessive force in the reduction of a congenitally dislocated hip. Ordinarily, however, in young children not past five years, the results are extremely satisfactory.

Open Incision.—This has been especially practised and popularized by Hoffa. An incision is made from below the anterior superior spine of the

ilium, downwards and outwards, across the top of the great trochanter, the tensor vaginæ femoris and gluteus are retracted, the fascia lata divided and the capsule split in a line with the incision. If necessary in order to obtain better exposure a cross incision is made into the capsule. The thigh is then raised to a right angle and the attachments of the capsule below thoroughly separated. The head of the bone is then pulled aside and the acetabulum exposed. The adherent capsule may be divided and the acetabulum curetted for the purpose of making a greater cavity for the reception of the head. The head of the bone is then reduced and the wound drained and closed. The limb should be fixed in a strongly abducted position and the thigh and pelvis enclosed in a plaster cast.

CHAPTER XIV.

ACCIDENTS AND SURGICAL AFFECTIONS OF THE HEAD AND NECK.

THE BRAIN.

It is essential before considering the injuries and diseases of the head and brain to review the more important anatomical landmarks connected with these structures.

The position of the various fissures. The fissure of Rolando is situated between the cerebrum and cerebellum and corresponds practically to a line drawn from the inion or external occipital protuberance to the external auditory meatus. This line practically marks the position of the lateral sinus. (Fig. 283.)

The position of the Rolando fissure. This fissure starts from a point back of the glabella or root of the nose 57 degrees of the distance to the inion, and runs downwards and forwards three and one-half inches at an angle of 67 degrees. In other words, the Rolando fissure commences half an inch behind the mid-point between the root of the nose and the external occipital protuberance.

In operative work upon the brain and in considering the location of tumors, hemorrhages and injuries, it is of the greatest importance to be able to locate the fissure of Rolando upon the exterior of the skull, because the motor centers and the centers of speech be contiguous to this fissure.

Fissure of Sylvius: To locate the fissure of Sylvius upon the external surface of the skull, draw a line from the external angular process of the frontal bone to the external auditory meatus. The fissure of Sylvius begins on this line, one and one-eighth inches behind the external angular process. The location of this fissure is of importance because it marks the site of the middle meningeal artery.

The superior longitudinal sinus is situated between the layers of the dura in the superior longitudinal fissure. In right-handed persons this sinus is placed slightly to the right of the median line in consequence of the over development of the left side of the brain.

DISEASES AND MALFORMATIONS INVOLVING THE SKULL. PERIOSTITIS, OSTEITIS, CARIES AND NECROSIS.

These processes occasionally involve the bones of the skull and run a course not specially different from like affections involving a bone or its coverings in other situations. These infections not infrequently follow in-

juries, especially injuries which are associated with infection. They occasionally follow typhoid fever, tubercular infection and syphilis.

TREATMENT.—The treatment of these conditions is practically the same as that of like affections elsewhere in the body. If infection with pus formation occurs, a free incision must be made, the part thoroughly asepticized and perfect drainage established. The dressings should be frequently changed and the part maintained in a thoroughly aseptic condition. Otherwise the danger of extension to the meninges is considerable. Retained pus in proximity to the bones of the skull becomes horribly offensive. If caries

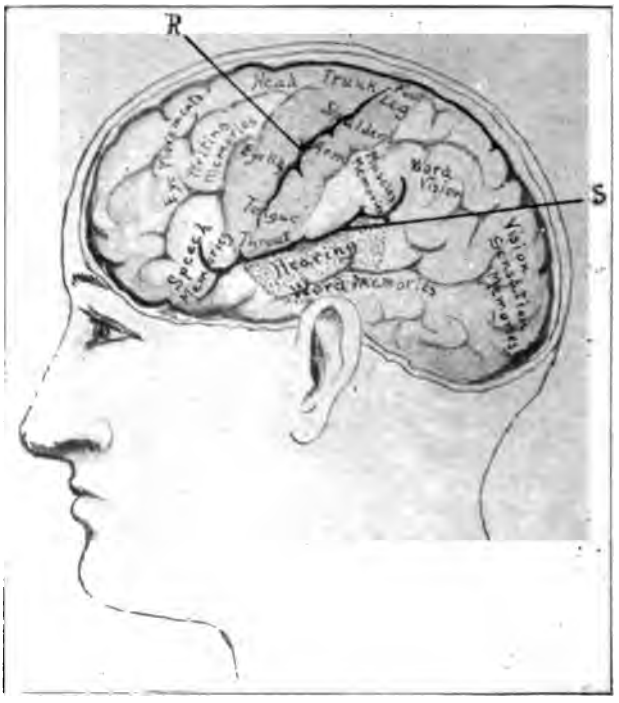


Fig. 283.—R. Fissure of Rolando. S. Fissure of Sylvius.

or necrosis occurs the bone should be freely exposed by incision with curette and chisel.

DISEASES AND MALFORMATIONS INVOLVING THE BRAIN. CONGENITAL AFFECTIONS.

Meningocele, encephalocele and hydroencephalocele are congenital affections in which there are malformations in the skull, membranes of the brain and brain. They are quite rare affections.

Meningocele consists in a protrusion of the membranes of the brain through an opening in the skull. The sac in these cases is distended by a fluid which is extra-cerebral. (Figs. 284 and 285.)

In encephalocele there is a tumor which consists of the membranes and a portion of the brain itself. The sac contains a fluid which is also extracerebral.

In hydrencephalocele there is a tumor which consists of the membranes, brain substance and a fluid, the fluid being in direct communication with the ventricles of the brain.

These tumors are most frequently situated, (1) in the median line, especially in the occipital region; (2) in the fronto-nasal region; and (3) at the side or base of the skull.

DIAGNOSIS.—These affections have been mistaken for abscess and tumor. They all are congenital, usually median and most frequently occipital.

Meningocele is cystic, fluctuates and is usually translucent. It is made more tense on straining and crying and is often pedunculated.

Encephalocele is usually small, opaque, does not fluctuate, but pulsates

Fig. 284.—Meningocele as large as the child's head.

Fig. 285.—Posterior view of Fig. 284.

distinctly, becomes more tense on crying, and has a wide base. If an attempt is made to reduce it symptoms of cerebral compression are produced.

Hydrencephalocele is often lobulated, at times slightly translucent, fluctuates, often pulsates, and is more tense on forcible expiration. In these cases the sac often has an imperfect skin covering, is raw and bleeds easily.

TREATMENT.—Hydrencephalocele is not amenable to operative treatment. The sac should be kept clean and protected by a dusting powder, a suitable dressing and a bandage.

Meningocele and encephalocele are usually amenable to surgical intervention. If untreated, as a rule, they gradually enlarge, become inflamed, infected and either rupture or the condition passes over into a fatal suppurative meningitis. Occasionally in consequence of a retrogressive process, and especially if the tumor is small and pedunculated, the pedicle may be constricted by the growth of the adjacent bones and a cure be effected. If an operation is not decided upon the growth should be kept clean and supported by a compress and bandage. In some cases the injection of a

drachm of Morton's fluid (which consists of iodine 10 gr., potassium iodid 30 gr., and glycerine 1 oz.) into the tumor has produced a shrinking of the growth, with favorable results. In proper cases the injection may be repeated every seven or eight days.

The operative treatment is most successful in pedunculated growths. In the operation three problems have to be met: First, thorough asepsis in order to prevent a suppurative meningitis; second, the prevention of the escape of much cerebro-spinal fluid during the operation; and third, the closure of the membranes in such a way as to prevent the subsequent escape of the cerebro-spinal fluid.

After thoroughly asepticizing the area of the tumor, the child is anæsthetized and placed in an inverted Trendelenburg position, so as to prevent as much as possible the escape of the cerebro-spinal fluid. If the growth is pedunculated, its base should be clamped, when suitable skin flaps are made and the excess of membranes excised. Before removing the clamp the membranes are accurately and firmly united with a continuous cat-gut suture. The suture line must be water tight. The clamp may then be removed and the skin surface accurately united over the first suture line. If the base cannot be clamped, after forming the skin flaps, the redundant membranes are excised and the cut surfaces quickly and accurately approximated by continuous suture. Over the suture line the skin is united. In suitable cases a goodly number of children may be saved by operative measures.

HYDROCEPHALUS.

This is a congenital or acquired condition in which there is an accumulation of fluid either within the ventricles of the brain or beneath the membranes.

EXTERNAL HYDROCEPHALUS.

In this form there is an accumulation of fluid beneath the membranes, and it is usually the result of atrophy of the brain, hemorrhage, softening, sclerosis or a cancerous or tubercular condition. The accumulation of fluid in these cases is compensatory or for the purpose of filling a cavity.

Treatment is simply symptomatic.

INTERNAL HYDROCEPHALUS.

In this form there is an accumulation of fluid in one or more of the ventricles of the brain.

It has been divided into three varieties, first, idiopathic internal hydrocephalus, first described by Quincke. In this form there is an ependymitis causing a serous effusion into the ventricles. The process may occur both in children and adults.

The symptoms are represented by headache, retraction of the neck, choked disks, slow pulse and often vomiting. In the acute form the process may be mistaken for a tubercular or suppurative meningitis; and in chronic cases for tumor. In the latter there are headache, slight fever, somnolence, delirium, exophthalmus, optic neuritis, spasms, rigidity and often paralysis of cerebral nerves.

CONGENITAL HYDROCEPHALUS.

The process may be so marked before birth as to interfere with or obstruct labor. Anatomically the lateral ventricles are enormously distended. The choroid plexuses are vesicular, sometimes thickened; the third ventricle is enlarged and the aqueduct of Sylvius dilated; the fourth ventricle may also be distended; the sutures in the skull are widely separated, the ganglia at the base flattened, the cortex greatly thinned, while the convolutions have disappeared.

ETIOLOGY.—It is held that chronic internal hydrocephalus is due to a congenital malformation or inflammatory affection causing exudation from the choroid plexuses, pressure upon the veins of Galen, the inferior longitudinal sinus or possibly closure of the foramen of Magendie.

SYMPTOMS.—The head in internal hydrocephalus becomes enormously enlarged, the face looks small and weak. The suture lines being widely separated, fluctuation is often present; the eyes protrude and the bones often crackle under the fingers. The child as a rule has frequent attacks of severe headache, accompanied by fever and vomiting. Mentally and physically the child is very defective, is often unable to walk, frequently understands but imperfectly, and speaks indistinctly, the mental faculties being very much disturbed. The process is often associated with paralysis of one or more limbs. The condition is usually progressive and goes on to death.

ACQUIRED CHRONIC HYDROCEPHALUS.

This condition is usually due to a tumor at the base of the brain, or in the third ventricle, compressing the venæ Galeni, or the foramen of Magendie through which the ventricle communicates with the cerebro-spinal meninges.

TREATMENT OF HYDROCEPHALUS.—The internal administration of iodid of potash has at times seemingly been of benefit in some cases. Surgically the ventricles have been frequently tapped, the trocar being inserted some distance from the median line and between the open sutures of the skull. Subsequently elastic pressure is maintained. In these cases, however, as the cause is not relieved the fluid quickly reaccumulates. It has been demonstrated that there is a direct absorption of fluid into the subdural veins if the pressure of the fluid remains above the venous pressure. Attempts have been made with some success to establish an opening between the ventricles and the subdural space for the purpose of having the excess of fluid absorbed.

CONCUSSION, CONTUSION AND LACERATION OF THE BRAIN. CONCUSSION OF THE BRAIN.

This is a clinical condition manifested by more or less complete suppression of the functions of the brain. It is the result of an injury to the skull in consequence of which a more or less severe commotion of the cerebral contents is produced without macroscopical, pathological change. Its severity varies greatly and in the mild cases will be represented by only a slight and transient stunning, dizziness or confusion of thought, while in the cases which are severe, insensibility and often death may occur. In moderately severe cases the patient is rendered unconscious for a few moments, then recovers, perhaps vomits, is confused, but in a short time fully

recovers from the effects of the injury. In more severe cases the patient lies insensible, the muscles are relaxed, the eyelids closed, the conjunctiva nonsensitive, and the pupils contracted. From this condition the patient will ordinarily recover in a short time, but may suffer from headache or some mental confusion for a day or two. In very severe cases the pupils are dilated, the surface of the body cold and clammy, the respirations shallow, the pulse feeble and often intermittent. The sphincters may be relaxed and death ensue. Ordinarily in concussion of the brain there is either a normal or sub-normal temperature. In all cases of injury to the head, a most thorough examination should be made in order to determine whether a fracture of the skull is present or not.

PATHOLOGY.—In concussion of the brain there are no macroscopical changes. Microscopically there may be molecular change followed by atrophy of nerve cells. The symptoms of shock are attributable to paralysis of the vaso-motor centers in the medulla, with reflex inhibition of the heart through the vagus. Duret has suggested that a blow upon the skull may cause temporary localized depression of the bone, which leads to compression of a cone-shaped area of the brain, with displacement of the cerebro-spinal fluid to the base and frequently into the fourth ventricle. The collection of cerebro-spinal fluid in this situation is supposed to produce inhibition of the vital functions. The clinical symptoms and pathological findings in cases of fatal concussion of the brain are practically the same as they are in shock.

TREATMENT.—In mild cases no treatment is required. In severe cases the patient should be put to bed with the head low and the body surrounded by hot bottles. A hypodermic injection of strychnin and caffein should be given, and a warm enema of coffee and milk administered. When reaction has taken place, and if excessive and attended with headache and fever, an icebag may be applied to the head and a purge administered.

CONTUSION OF THE BRAIN.

This is the result of severe injury to the skull. A contusion may be localized or diffuse, and confined to the meninges or cortical substance of the brain. It has been shown by Phelps that pathologically a contusion is represented by hyperæmia, punctuated hemorrhages, multiple thrombi of the small vessels and œdema of the affected area. A contusion is a much more severe condition than is a concussion, and may be followed by serious sequelæ, such as meningeal inflammation, which may become suppurative in consequence of infection, or by localized abscess.

SYMPTOMS.—In mild cases there is usually loss of consciousness, which is of variable duration, vertigo, mental confusion, with a sense of great bodily weakness, and headache. In the cases which are more severe there is unconsciousness or a dazed condition which may persist for a day or several days, followed perhaps by stupor, somnolence, headache, vertigo, irritability and restlessness. The temperature ranges from 99 to 100 degrees, the respiration and pulse are quickened, the pupils are usually normal, but may be either contracted or dilated. In some cases of contusion associated with moderate hemorrhage, there is delirium, great restlessness, with rigidity of muscles or even convulsions. Contusion of the brain is likely to leave

the patient mentally weak for a considerable time, with headache, confusion of ideas and loss of memory.

TREATMENT.—The patient should be kept quiet in bed until all the graver symptoms have disappeared. The bowels should be kept freely open, and if there is much headache or fever an icecap is to be applied to the head. The bromides or ergot may be given for the purpose of controlling restlessness and inducing sleep or lessening the amount of blood in the brain. After the acute symptoms have disappeared, small doses of strychnin may be given with advantage. If a localized suppurative meningitis or cerebral abscess occurs, trephining should be done and the infected area drained.

LACERATION OF THE BRAIN.

This is a more serious lesion than uncomplicated contusion, and is represented by contusion, a distinct rent of the brain, and often of the membranes, with hemorrhage. The rent may be comparatively slight in extent or be represented by a complete disorganization of a convolution or lobe of the brain. Laceration of the brain is always associated with hemorrhage, which may be slight in extent or be very profuse, and the cause of a fatal termination.

SYMPTOMS.—There is usually unconsciousness, which may be comparatively brief or continue until the death of the patient. In cases which are at all severe and consciousness has been retained the patients are lethargic or stupid. They can be roused but only comprehend indifferently. In lacerations of the left frontal lobe there is often delirium and hallucinations and the patients as a rule have to be restrained. The pulse and respiration are not specially altered. The most characteristic symptom of laceration is a rise in temperature. With very few exceptions, according to the tables of Phelps, there is a rise in temperature during the first twenty-four hours and often during the first nine hours, or from 3 to 6 degrees, and this rise is maintained or increased up to the time of the death of the patient.

TREATMENT.—It should be understood that laceration of the brain *per se* is not amenable to surgical interference. In the local treatment an icebag should be applied to the head and then the bowels thoroughly opened. Liquid food is administered if necessary per rectum. In case of unconsciousness the urine should be drawn at regular intervals. If there are symptoms of cerebral compression without fracture, such as unconsciousness, dilated pupil, paralysis, slow pulse, and slow, stertorous respiration, the condition is almost certainly due to hemorrhage, and a trephining should be done, the clot of blood removed, the bleeding vessel ligated and probably the area drained with a few strands of catgut.

COMPRESSION OF THE BRAIN.

Compression of the brain is a clinical condition in which the intracranial pressure is abnormally increased.

The traumatic causes of compression of the brain are intracranial hemorrhage, fracture of the skull, with depression, inflammatory exudate, spreading œdema, abscess and foreign bodies.

The idiopathic causes are hemorrhage, tumors and abscesses.

SYMPTOMS.—In compression which is marked unconsciousness is complete, the patient not responding to the loudest shouting: the pulse is slow, often below 60, respiration is infrequent, labored and often stertorous: one or both pupils are dilated and do not respond to light: the pupil on the side of the lesion is usually the one dilated: there is paralysis, often hemiplegia, with disturbance or loss of sensation. If the compression is circumscribed and cortical, the paralysis may be confined to a certain group of muscles, as those of an arm, those of the face or of an eye. The bladder and rectum are usually paralyzed.

The vessels usually ruptured as a result of traumatism are either the middle meningeal or middle cerebral, or some one of their branches. In the former case, which is by far the most frequent, the clot will be situated outside of the dura, that is, between the dura and the skull. In the latter, it will be situated between the dura and the brain. In hemorrhage from the middle cerebral or its branches the clot will be situated along the Sylvian fissure, at the base or over the side of the head. In hemorrhage from the middle meningeal the clot will be situated along the course of this vessel or some of its branches, and will most frequently be located in the temporal region, perhaps extending to the base or over the side of the head. If the posterior branch is ruptured the clot will be above the corresponding ear.

It must be taken into consideration that the vessel ruptured is not necessarily the one towards the seat of the injury, because not infrequently the force is a transmitted one and the vessel ruptured is upon the opposite side of the head to the situation of the injury.

DIAGNOSIS.—In compression of the brain due to a depressed fracture or to a foreign body the symptoms come on at once. There is usually no interval of consciousness after the receipt of the injury.

In compression of the brain due to hemorrhage, the course of the symptoms is usually as follows: The patient receives a severe blow or falls forcibly upon his head; he is stunned for a period as the result of the concussion of the brain; he soon, however, recovers consciousness and perhaps goes about his work with no thought of his condition, other than suffering from a slight confusion, perhaps of thought, or dizziness; after one, two or more hours he becomes drowsy, indifferent, and finally completely unconscious, with paralysis of one half of the body; the pulse is slow, the respiration is slow and stertorous, and the pupil on the side of the lesion is dilated and does not react to light. In severe cases the unconsciousness is continuous until death, or until the removal of the clot by operative measures. The interval of consciousness after the receipt of the injury and the recovery from the stunning is extremely important in a diagnostic sense.

The sequence of events is as follows: The blow causes concussion of the brain and unconsciousness and at the same time ruptures a blood vessel. The patient quickly recovers from the stunning and only again becomes unconscious when enough blood has poured out from the ruptured vessel to cause compression of the brain. In cases in which a large vessel is ruptured the blood may be poured out so rapidly that compression of the brain from the blood will occur before the stunning from the blow has been recovered from. Consequently the patient passes from a condition of unconsciousness

due to the stunning, to a condition of unconsciousness due to compression of the brain from the blood clot without an interval of consciousness. In some cases in which unconsciousness is produced, but the clot is not large, sufficient absorption may occur so that the patient becomes conscious and regains his health without the aid of an operation.

DIFFERENTIAL DIAGNOSIS.—[illegible] in the street by the police, in an unconscious condition and having the smell of liquor about them, they are carried to the police station [illegible] and locked up as drunk. In many of these cases they [illegible] and a post mortem examination shows a severe [illegible] have been the cause of their unconsciousness. [illegible] differentiated from compression are drunkenness [illegible] uræmia and sun stroke; and finally, it should [illegible] more of these conditions may be present [illegible] the patient is not unconscious and can be [illegible] the patient is not paralyzed [illegible] to pin points, the patient can [illegible] paralysis. In uræmia, paralysis and [illegible] should always be examined [illegible] the season of the year and the intense heat [illegible] will be of advantage [illegible] the face is flushed, the pulse rapid and [illegible] ranges from 107 to [illegible] degrees [illegible] the patient having taken [illegible] and the contents examined. In [illegible] the patient should be watched for a day [illegible] spreading œdema of the brain and [illegible] the process usually makes its appearance [illegible] following the injury, is progressive and [illegible] from a hemorrhage. It occurs, however, slightly [illegible] hemorrhage. The treatment, however, is practically the same. [illegible] abscess subsequent to a traumatism occurs [illegible] by this fact from hemorrhage. In [illegible] from the lenticulo-striate artery occurs in persons [illegible] vessels, and results usually in immediate unconsciousness [illegible] however, partially or completely recovered from in one or two days [illegible] followed by hemiplegia.

TREATMENT OF HEMORRHAGE. This may be considered under two heads: extradural hemorrhage, or that which comes from the middle meningeal vessel, and subdural hemorrhage, or that which comes from a branch of the middle cerebral.

The main branch of the middle meningeal artery may be reached by applying a trephine an inch and a half behind the external angular process of the frontal bone and on a line extending from this process to the external auditory meatus. A reasonably large disc of bone should be removed, and if a clot is found beneath the bone, the opening can be readily enlarged by a Rongeur forceps.

The posterior branch of the middle meningeal vessel may be reached by applying a trephine directly above the external auditory meatus. This

FRACTURES OF THE BASE OF THE SKULL.

These fractures are either the result of a linear fracture extending from the vault to the base, or are the result of force applied to the feet, buttocks or top of the head, or to the lower jaw, or of punctures through the eye, ear, nose or mouth.

Fractures of the base may involve the anterior, middle or posterior fossa. The middle fossa is most frequently involved.

The gravity of fractures of the base is largely in consequence of their being usually compound, difficult to asepticize and frequently infected.

SYMPTOMS. Headache and vomiting with quickened pulse and respiration, are usually present. In fractures through the anterior fossa, blood is likely to appear in a day or two in the conjunctiva, and later in the eyelids. It is difficult to establish positively the existence of a punctured fracture through the eye, nose or mouth, unless perhaps there is an escape of brain substance. In fractures of the posterior fossa a symptom of importance is the area of ecchymosis, which reaches the skin and occiput outside of the tip of the mastoids. The blood is unable to pass directly up the back of the cervical bone in consequence of the attachment of the deep cervical fascia; consequently it passes around the tips of the mastoids and makes its appearance above the superior curved line of the occipital bone.

Perhaps the most characteristic and at the same time most frequent symptom of fracture of the middle fossa is bleeding from one or both ears. This occurs in fractures through the petrous portion of the temporal bone, associated with rupture of the membrana tympani. The hemorrhage often continues for days, or for a day or two, and then is followed by the escape of a considerable quantity of thin, serous fluid. The escape of fluid is increased by the dependent position of the head and by coughing, sneezing or straining. A fracture of the petrous portion of the temporal bone may be compound through the Eustachian tube without rupture of the membrana tympani. Fracture through the petrous portion of the temporal bone may cause paralysis of the facial, auditory or optic nerves. Paralysis of one of these nerves if taken in connection with the other symptoms, is usually considered conclusive of fracture.

PROGNOSIS. Fractures of the base must always be considered as serious lesions. If there is an absence of severe hemorrhage, and the brain is not seriously injured, and infection can be prevented, the patient is likely to recover.

TREATMENT. This consists largely in preventing infection if possible. If the anterior or middle fossa has been opened through the orbit by some foreign object, as a sharp stick or splinter, which was septic, the wound of entrance should be thoroughly exposed, splinters of bone removed, the wound asepticized and drained. This may require the removal of the eye or a trephining through the frontal or temporal region.

The principles of treatment in this situation are to remove, if possible, the foreign body, thoroughly asepticize the wound, and establish free drainage. Following this the wound must be maintained in a thoroughly aseptic condition until healing has been effected. Foreign bodies which have entered the anterior fossa through the nose and cribriform plate of the ethmoid, present serious difficulties. In these cases the nasal cavity should

be thoroughly asepticized and lightly plugged with iodoform gauze. The plugging is changed and the irrigation repeated two or three times each twenty-four hours. The best drainage is secured through the nose. If necessary the anterior fossa and horizontal plate of the ethmoid may be exposed by making a large trephine opening through the frontal bone at the root of the nose, and lifting the brain.

FRACTURES OF THE PETROUS PORTION OF THE TEMPORAL BONE, WITH RUPTURE OF THE MEMBRANA TYMPANI.

In these cases the external auditory meatus should be mechanically cleansed with swabs of sterilized cotton, soap and water. After this the meatus is gently irrigated with some mildly antiseptic solution, and then lightly plugged. The naso-pharynx should also be cleansed, because infection may occur through the Eustachian tube, to the middle ear, and from here infection may reach the membranes at the base of the brain. These fractures are liable to be complicated by injury to the facial or auditory nerves with facial paralysis or deafness upon the side injured.

WOUNDS OF THE BRAIN.

These are produced by the kicks of animals, by falls, by penetration of knives, bullets, sharp sticks, etc. They may be received through the vault or at the base. In the latter situation the wounds are most frequently received through the nose, orbit or mouth. They are all associated with fracture of the skull and are practically all septic.

The symptoms will vary with the extent of the injury and the region injured. They may be slight or very severe, depending on the extent of the concussion, contusion or laceration of the brain, as well as upon the extent and situation of the hemorrhage, and upon the absence or presence of infection. If infection takes place, there will be headache, vomiting and fever, followed usually by delirium, coma and death. If the injury to the brain is not incompatible with life, and severe hemorrhage and infection can be prevented, the patient is likely to recover.

The principles of treatment are to control hemorrhage, if this is present, to shave the head if the wound is on the vault, and to thoroughly asepticize the parts, to remove foreign bodies that are accessible, and to drain the wound.

INTRACRANIAL INFLAMMATIONS.

Inflammation of the contents of the cranium is nearly always of pyogenic origin. It frequently follows injuries such as compound fractures, middle ear disease, suppurative inflammatory processes of the scalp, bones or sinuses of the skull. It also may be secondary to some one of the infectious fevers, suppurative processes in other parts of the body, osteomyelitis, ulcerative endocarditis and suppurative processes in the lungs. The organisms reach the cranial contents in consequence of continuity or contiguity of the structure, or through the lymphatic or blood vessels. The organisms which are most frequently the causative factors of these inflammations are the staphylococcus, streptococcus, pneumococcus, bacillus pyocyaneus and the bacillus coli communis.

INFLAMMATION OF THE DURA OR PACHYMENINGITIS.

This is a localized process which may result from a slightly depressed or fissured fracture, or from a circumscribed infection in the overlying bone. If the process remains local the symptoms are mild. There will be local tenderness and swelling with headache. The constitutional symptoms may be represented by slight fever and malaise.

The treatment should be directed to asepticizing the wound, if one exists, providing free drainage, keeping the patient quiet and opening the bowels.

EXTRA-DURAL CIRCUMSCRIBED ABSCESS.

This may be due to a compound or punctured fracture in which the dura has been separated from the bone over a small area, to a small fracture with effusion between the bone and dura, followed by infection, to

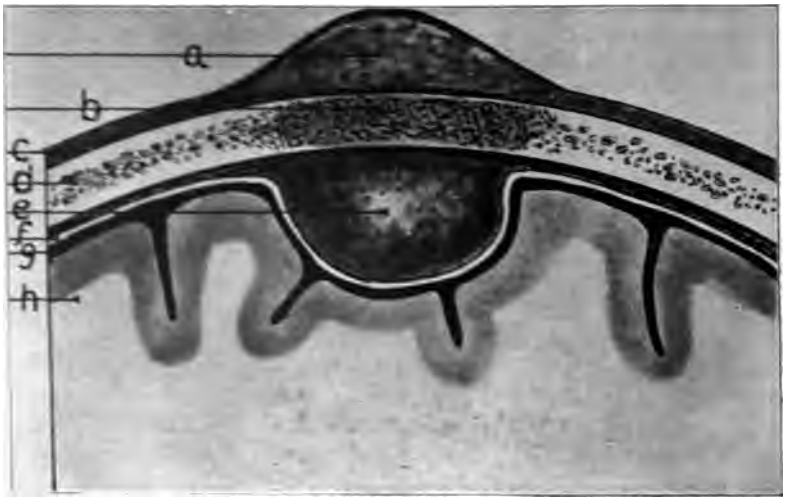


Fig. 28[illegible]—Extra-dural abscess. a. Pott's puffy swelling. b. Inflamed bone. c. Scalp. d. Cranium. e. Abscess. f. Dura mater. g. Sub-dural space. h. Brain.

osteomyelitis of any portion of the bones of the skull, or to middle ear disease (Fig. 280).

SYMPTOMS.—These are primarily those of a suppurative process. There is usually high fever, rigor, severe headache and localized tenderness. If the abscess reaches any considerable size, there will be symptoms of cerebral compression, such as slow pulse, dilated pupils, slow and stertorous respiration, and coma. An œdematous swelling of the scalp may appear at the site of the suppurating process. When there is a compound fracture the margins of the wound are unhealthy and the bone bare. Local symptoms of spasm or paralysis may also occur.

TREATMENT.—This consists in affording by incision free drainage for the pus. In compound fractures the wound should be asepticized and enlarged, and the bone, if necessary, cut away and the cavity thoroughly drained.

In middle ear disease the mastoid, as well as the antrum and attic, should be freely opened and drained. It should be thoroughly understood that these processes may not be entirely or principally extra-dural, but that the infection may implicate the soft membranes and brain substance and produce a spreading inflammation or a localized abscess.

ACUTE MENINGO-ENCEPHALITIS.

This is an infectious process which invades the meninges and superficial parts of the brain. The process not infrequently occurs after compound fractures. The symptoms usually make their appearance at the end of the second day following the injury. Primarily there is a severe and increasing headache, high fever, quick pulse, cerebral vomiting, intolerance of light, constipation, retracted abdomen, delirium, twitching of muscles, later coma and slow pulse, the condition being usually followed by death. In acute meningo-encephalitis confined to the vault, convulsions are frequent. If the affection implicates the structures at the base of the skull, retraction of the neck, optic neuritis and squint are also frequent.

Post Mortem Conditions.—The dura is thickened and congested, the cerebro-spinal fluid is increased and turbid from the admixture of pus and lymph, the convolutions are flattened and œdematous, the ventricles are distended, and the choroid plexuses engorged.

Treatment.—This should at first be prophylactic. Every wound involving the scalp, and especially the skull, should be thoroughly cleansed and drained. After the process has become established, attempts have been made to control the inflammation by trephining, aspticizing and draining the infected area. The process, however, when once established, seems beyond surgical control. Cold should be applied to the head, the bowels kept open and pain relieved.

SUBACUTE MENINGITIS.

This form of inflammation sometimes comes on at a late date following an injury. The postponement of the symptoms may be due to a lessened virulence of the infection, the small number of micro-organisms, or it may be due to the process being dormant for a time. The symptoms are similar in character, but less severe than in the acute cases. The treatment is practically the same as for the acute cases.

INFECTIVE THROMBOSIS OF THE SINUSES.

The lateral, longitudinal and cavernous sinuses may become infected. The infection may follow injuries of the head or scalp, erysipelas and suppurative affection of the face and nose. Thrombosis of the lateral sinus is most frequently the result of middle ear disease. Pathologically the condition is like a septic phlebitis. The sinus becomes plugged with a thrombus, which, being septic, breaks up into innumerable emboli. The sinus and the surrounding tissues may be the site of abscess formation.

The symptoms are represented by severe pain in the head, most acute over the site of the thrombus, high fever, vomiting, chills and sweating. The lungs may become involved and there may be dyspnœa; or the symptoms may be largely those of pyæmia. If the cavernous sinus is involved, marked exophthalmos with congestion of the eyelids is usually present.

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If the superior longitudinal sinus is the site of the thrombus, the veins of the scalp and forehead will be turgid, and there is likely to be tenderness in the scalp over the seat of the lesion, and epistaxis. In thrombosis of the lateral sinus the general symptoms are those of a severe infection, high fever, vomiting, chills, and pain in the side of the head, and an indurated swelling which extends into the neck at the site of the internal jugular vein. The region of the lateral sinus is very tender. There will usually have been a chronic discharge from the ear which at the time of the onset of symptoms disappears. Suppuration may occur outside of the sinus and in the surrounding tissues.

TREATMENT.—If the thrombus is situated in the lateral sinus, this should be exposed by applying a trephine one inch behind the external auditory meatus. Pus will often be found outside of the sinus, and if this is the case it should be carefully washed away. The sinus is then explored with a hypodermic needle, and if it contains coagulum the internal jugular vein should be exposed by making an incision along the anterior border of the sterno-mastoid, ligating the internal jugular well below the seat of the thrombus, so that in the manipulations no more infected emboli may enter the general circulation. The sinus is then thoroughly opened and washed out. When all the clot has been removed hemorrhage will occur from the proximal end of the sinus and can usually be controlled readily by a plug of gauze. If the vein in the neck is thrombosed, it should be opened and washed out. The wounds are then lightly packed and dressings applied.

ABSCESS OF THE BRAIN.

Abscess of the brain is the result here, as elsewhere, of either pyogenic or tubercular infection; in the great majority of cases it is due to pyogenic infection.

The predisposing factors are: (1) Injuries of the head, including lacerations of the scalp, and compound fractures. In these cases the pus is usually superficial. It may, however, be situated deeply in the structures of the brain, and be due to a punctured wound or to infection carried in by the lymphatics or blood vessels. Infection is especially likely to occur if there has been a contused or lacerated area within the brain.

(2) It may arise as the result of an abscess or suppurative process in the scalp, the infection reaching the brain by continuity of tissue.

(3) Nearly one-half of the cases of cerebral or cerebellar abscess are due to chronic otorrhœa, in which the petrous portion of the temporal bone has become necrosed or infected. In these cases the infection may reach the brain in consequence of the continuity of structure, through the circulation, or the infection may spread from the tympanic cavity or mastoid to the membranes and from there to the brain substance. The abscess in these cases is situated as a rule either in the tempero-sphenoidal lobe or in the anterior portion of the lateral lobe of the cerebellum.

(4) An abscess may be secondary to infection of the frontal sinus, in which an acute osteomyelitis has occurred. The pus in these cases is usually situated in the anterior portion of the frontal lobe.

(5) The process may be secondary to infection of the ethmoidal or sphenoidal sinuses or to thrombosis of the cavernous sinus (Fig. 287).

(6) The abscess may be secondary to acute osteomyelitis of some one of the bones of the extremity, ulcerative endocarditis, septic disease of the lungs, or to pyæmia. These abscesses are usually single, although there may be two, one situated in the cerebrum and the other in the cerebellum.

SYMPTOMS.—In traumatic cases where an infected wound or compound fracture is the source of the infection, the course is usually very acute, and there is often an associated suppurative meningitis. The symptoms are represented by intense headache, vomiting, repeated rigors, rise of temperature and pulse, delirium, convulsions, twitchings and coma, usually followed by death. In some cases without involvement of the membranes there may be only headache, when without warning the abscess bursts into a lateral ventricle or subdural space, when the condition will be followed by high fever, often coma and death.

In cases which are reasonably typical, Macewen has divided the symptoms into three stages. In the first stage, which lasts from 12 hours to 2

Fig. 287.—Cerebral abscess. b, Inflamed bone. c, Scalp. d, Cranium. e, Abscess. f, Dura mater. g, Subdural space. h, Brain.

or 3 days, there is severe pain in the head, especially about the ear, with quickened pulse, fever, vomiting and a chill. During this stage the discharge from the ear will have diminished.

In the second stage, when the symptoms are fully developed, the patient is in a partially comatose condition, with subnormal temperature and a slow pulse. The headache is less severe, the vomiting and constipation continue. There is likely now to be optic neuritis and symptoms of paresis or paralysis.

In the final stage unconsciousness becomes profound and ends in death.

In cerebellar abscess, in addition to the symptoms already enumerated, there is marked vertigo with retraction of the head and neck.

An abscess of the brain is to be differentiated from meningitis from the facts that it occurs at a later date following an injury than does inflammation of the meninges—that is, about the end of the first week; that the temperature is lower, often normal or subnormal—and that both the pulse

[illegible]

[illegible]

[illegible]

[illegible] is carried out by [illegible] and applying a [illegible] of the meatus and [illegible] has been removed [illegible] and if [illegible] make its appearance the brain is [illegible] a pair of small artery forceps, or a grooved director, in a [illegible] forward and inwards, or towards the opposite ala [illegible] not reached, the grooved director may be withdrawn

and reinserted, taking a slightly different direction. When the pus cavity is reached the opening is eniarged by separating the blades of the forceps and withdrawing them in this position. A small drainage tube is then inserted and the abscess cavity gently syringed out. For the purpose of opening an abscess in the cerebellum, a suitable flap is turned down below a line extending from the inion to the external auditory meatus, the fascia and muscular tissue scraped away, and a gouge applied one and one-half inches behind the external auditory meatus and one-fourth of an inch below Reid's base line. After the removal of the bone, the dura is incised and the cerebellum punctured with a grooved director. If an abscess is found it is treated as in the case of an abscess of the cerebrum.

EPILEPSY.

There has been a good deal of indiscriminate operating for the cure of epilepsy; consequently but few cases have been relieved in proportion to the number operated on. It seems pretty well established at the present time that the only cases of epilepsy which are benefited by operation are those which partake of the Jacksonian type—that is, those in which consciousness is not lost, and the convulsive seizure does not become general, but is confined to a certain group of muscles.

CONGENITAL EPILEPSY.

This is often the result of some injury at the time of birth. There may also be other manifestations of cerebral mischief, such as spasms, paralysis or defective growth. If the seizures remain local, an early operation is indicated.

TRAUMATIC EPILEPSY.

This is a form that is most often amenable to surgical treatment. The exciting cause of the epileptic seizure may be (1) neuralgic or irritable cicatrices in the scalp, (2) a depressed portion of the skull as a result of fracture, (3) excessive callous following fracture, (4) a localized meningitis, the result of traumatism and attended usually with hemorrhage or fracture.

The symptoms will depend upon the area affected. In favorable cases there will be convulsive seizures, always implicating a certain group of muscles. These seizures may remain local or become general.

TREATMENT.—Neuralgic, irritable or inflamed cicatrices should be excised, especially if pressure upon them excites an epileptic seizure or aura. It should be remembered, however, that operative measures to be successful must be undertaken early, before the epileptic habit becomes established. If more than two years have passed since the first epileptic seizure, operative measures are usually useless. As stated, all neuralgic and sensitive scars should be excised, depressed bone should be raised or removed, and if there are thickened membranes corresponding to the site of the nervous discharge they should be excised, and even the discharging nerve center may be removed. Where the membranes are adherent to the bone, sterilized gold or silver foil may be placed between these structures for the purpose of preventing subsequent adhesions.

TRAUMATIC INSANITY.

This is a condition following an injury as a causative factor. If there is a pathological lesion, such as a tender cicatrix or depressed bone, or probable injury to the membranes or brain, the diseased structures should be removed.

INVETERATE HEADACHE.

Occasionally an injury to the scalp, skull, membranes or brain is followed by an inveterate headache, making the patient's life unenjoyable and even miserable. In these cases, if there is a tender cicatrix, inflamed, thickened or depressed bone, or probably adherent membranes, these structures should be removed.

HERNIA CEREBRI.

By this is meant the protrusion of brain substance through an artificial opening in the skull. The condition is caused either by an increase in the intercranial pressure or to sepsis. In case of inoperable cerebral tumors, if the skull is trephined and dura incised, the brain in consequence of the increase of the intercranial pressure will project strongly into the wound and beneath the scalp, after this has been turned down. In cases of compound fracture and in operations upon the brain, when the dura remains quite widely open, if infection occurs, hernia cerebri is likely to follow. This is occasioned by the rapid growth of granulation tissue taking origin from the neuroglia. This growth takes the form of a fungous mass, is very soft, grows rapidly, bleeds easily, pulsates vigorously, and gives off a most disagreeable odor unless treated vigorously with disinfectants.

TREATMENT.—Prophylactic. Infection, if possible, should be prevented and the dura closed, as a hernia cannot take place unless the dura is open, and usually does not occur unless the part has become infected.

A commencing hernia cerebri should be frequently and very thoroughly cleansed and pressure made by the use of a compress and bandage. If the fungous mass continues to grow it may be excised and even cauterized, thoroughly cleansed and over this area a zinc ointment applied upon a cloth, and then a compress and bandage. There need be no fear ordinarily of excising a fungous mass, because although it seems to be made up of brain tissue, it is in reality made up of granulation tissue.

HARE-LIP.

Hare-lip is a congenital defect of varying extent. It is spoken of as being complete and incomplete. In the complete hare-lip the fissure extends into the nostril, in incomplete it only extends through the lip. Hare-lip is also spoken of as being simple, when the cleft is confined to the soft parts; alveolar when the alveolus is also cleft; complicated when associated with cleft palate; unilateral if upon one side, and bilateral if both sides are cleft. There is some difference of opinion as to the exact method of failure of development by which a hare-lip is produced. The defect is seemingly caused by a failure of union between the internal nasal on the inside and the external nasal maxillary processes on the outside. If the cleft involves the alveolar border it is placed either between the maxillary and intermaxillary bone, that is external to the lateral incisors, or it is

Fig. 288.—Single hare lip.

situated between the incisor teeth. A hare-lip which extends into the nose causes flattening and deformity of that side of the nose. In double hare-lip the central portion is often shorter than the remainder of the lip, and projects strongly forwards, while the nose at its tip is usually very flat. The cleft may be but a slight notch, implicating but little more than the border of the lip, or extend entirely through the hard and soft palate. The cleft is most frequently situated upon the left side. The two margins of the lip are very often unequal in depth (Fig. 288).

TREATMENT.—Under ordinary conditions the most suitable time for operation is between the third and sixth month in healthy children. Weakly children should not be operated on so soon, and under ordinary conditions a child should not be operated for hare-lip during the hot months of summer (Fig. 289).

The objects to be attained by the operation are, first, to obtain primary union; second, to obviate a notch of the vermilion border; third to have

Fig. 290.—Showing projection of inter-maxillary bone.

the lip, after union, of the same depth; fourth, to have the vermilion border exactly upon the same line; fifth, to procure a strong and broad union (Fig. 290).

In an ordinary case the operation is carried out as follows: The child is lightly anæsthetized and securely held in the lap by a nurse. A second nurse supports the head. The operation is commenced by seizing the lip at the lower borders with catch forceps. The lip is then turned upwards and the mucous membrane and muscular structures connecting it with the gums freely and quite widely divided. This is necessary in order to be able subsequently to approximate the surfaces without tension. The next step is the paring of the edges of the cleft. This may be accomplished by entering a sharp, slender knife just above the apex of the cleft and carrying the incision downwards and outwards, so that it will be convex externally. The beveled edge of the lip must be entirely removed; and just before the

Fig. 291.

Fig. 292.

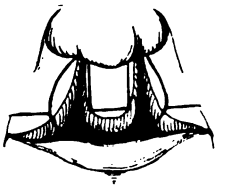

Fig. 293.

Fig. 294.

knife reaches the vermilion border it may be turned inwards so as to make the lower edge full and protrude slightly after union. After the two sides have been pared the vermilion borders are accurately united with silkworm gut, the needle passing through all of the structures excepting the mucous membrane. Three or four additional sutures are then introduced, after which the lip is turned upwards and two or three catgut sutures made to unite the mucous surfaces. The line of incision should then be supported by placing a pledget of gauze directly over the sutures, and carrying a piece of adhesive plaster from one cheek to the other, pressing the cheeks forward as the adhesive plaster is applied.

If the alveolar border is cleft, the surfaces, if not far separated, may be freshened, forced together and united with catgut.

In double hare-lip the intermaxillary portion should ordinarily, if prominent, be forced backwards into place, when the central skin portion may be pared either in the form of a square or in that of a V. The lateral

flaps are then cut so as to approximate this V-shaped or square piece and united below it in the median line (Figs. 291, 292, 293 and 294).

MACROCHEILIA, OR HYPERTROPHY OF THE LIPS.

This may be a congenital condition in which some portion or all of the lip becomes greatly hypertrophied. In the congenital cases the enlargement is due to a chronic lymphangiectasis.

The treatment consists in removing a V-shaped piece from the affected portion of the lip. The acquired form is usually either tubercular or syphilitic, or the process may be due to a chronic lymphangitis, the result of pyogenic infection. If the process is due to syphilis, internal treatment should be administered; otherwise the affected and enlarged portion of the lip may be excised.

SUPPURATION WITHIN THE ANTRUM—EMPYEMA OF THE MAXILLARY SINUS.

This process may be acute or chronic. It usually has its origin either from an infectious process within the nose, or within an adjacent tooth socket. In the chronic form there is an intermittent discharge of pus from the nose, with pain and heaviness within the antrum. The pus varies considerably in amount and makes its appearance when the patient holds his head forward or to the opposite side. In the acute cases the opening from the nose to the antrum is often partially or completely closed, and the pus is retained, causing severe pain, high fever and often marked swelling in the soft parts over the antrum. The antrum in these cases is very tender to pressure.

DIAGNOSIS.—This is established by considering the intermittent discharge of pus from the nose, which is favored by the dependent position of the head, by the pain and tenderness, and by trans-illumination.

TREATMENT.—Under ordinary conditions the antrum is drained by incising the mucous membrane above the bicuspid and first molar teeth, and then gouging an opening in the anterior wall of the antrum, sufficient to admit the finger. In chronic cases there may be innumerable polypi attached to the walls of the antrum. When this condition is present the walls of the antrum should be thoroughly curetted, care being taken, however, not to use sufficient force to cause a fracture of the bone. If the opening into the nose is narrowed or obstructed, preventing drainage, it should be enlarged. The cavity should be thoroughly syringed out two or three times each twenty-four hours, with some mildly antiseptic solution, and the drainage maintained until the pus disappears. In acute cases drainage may be established through the cavity of a previously extracted tooth. If a dead root has been the occasion of the infection, this should be extracted and the cavity drained through the alveolus.

DEPRESSION OF THE BRIDGE OF THE NOSE.

(For fracture of the nasal bones, see Chapter on Fractures.)

This may be the result of a depressed fracture, of syphilis or tuberculosis, or be congenital in origin. When occurring as the result of a depressed fracture, the depressed bone should be immediately raised and held

in position by packing that nostril with iodoform gauze. The packing is removed each day, the cavity syringed out and fresh gauze reintroduced.

In cases in which the position of the bone cannot be corrected, subcutaneous injections of paraffin have been resorted to with success. Paraffin is employed which melts at 110 degrees F. This is slowly injected into the subcutaneous tissue over the site of the defect, and molded into shape. At the time of the injection pressure with the fingers must be made about the defect, to prevent the paraffin invading the surrounding loose tissues.

But a small amount—that is, 15 to 30 minims, should be injected at a sitting. The injections may be repeated as soon as the reaction has subsided.

PARTIAL OR TOTAL DESTRUCTION OF THE NOSE.

This may result from traumatism, from syphilis or from malignant processes. The deformity is extremely unsightly and various methods have been practiced for its correction. If the bridge of the nose is largely retained the correction of the deformity is not difficult. Various methods of rhinoplasty have been followed. When the defect is confined to the alæ of the nose, or is of limited extent, the flap is usually taken from the cheek; the borders of the defect are freshened and then a flap is marked out upon the cheek one-third larger than the defect, with its pedicle toward the nose. The flap is then dissected up, twisted on its pedicle, and stitched to the freshened margins of the defect. The wound from which the flap was taken is closed by suture or skin grafting. When the flap has been thoroughly united the pedicle is divided and the redundant tissue cut away.

In cases in which the major portion of the nose has to be built up, the flap is taken either from the forehead or arm. In the former case the periosteum and superficial layer of the bone are removed for the purpose of giving firmness, shape and form to the new nose.

When the flap is taken from the arm the hand has to be bound to the head until union is complete.

In cases in which much of the nose has to be rebuilt, it is well to make a pattern on paper of the desired size of the flap, and to lay this down upon the forehead, and mark out the area with an indelible pencil. Otherwise the flap is often found to be misshapen and too small. The pedicle in case the flap is taken from the forehead should be narrow, not more than three-fourths of an inch in width, and be situated somewhere near the root of the nose. It has been recommended that the pedicle include the supra-orbital artery and nerve.

FOREIGN BODIES IN THE NOSE.

Children often insert within the nose beans, peas, buttons and other foreign substances. A dry bean or pea will swell up with the absorption of moisture and cause obstruction of that side of the nose. A hard substance will cause ulceration.

In case of acute discharge from the nose, without assignable cause, the nares should be examined for foreign bodies. The foreign body, if in the anterior portion of the nares, can readily be extracted by introducing some flat instrument, like a long-handled ear spoon, or a grooved director or a slender curette, above and behind the foreign substance, and then by

pressure dragging it out of the nostril. In children head and hands must be held during this process. The nose after the extraction should then be gently syringed with some mildly antiseptic solution.

OZENA.

This name is now applied to an atrophic rhinitis—rhinitis sicca. The condition is most frequently found in young women, and may be the result of traumatism, the exanthematous diseases, tuberculosis or syphilis, or be the result of a long continued and chronic inflammation of the mucosa. The mucous membrane is often atrophied, the nostrils are unduly open, while the secretions cling as crusts to the mucous surfaces. The retained secretions undergo decomposition and are most offensive. There is associated chronic pharyngitis.

TREATMENT.—The nasal cavity should be kept clean and free from decomposing secretions and crusts by frequent douches. After thorough cleansing a bit of medicated gauze or cotton may be introduced into the nostril for the purpose of lessening the space and causing a greater secretion, and thus preventing the formation of crusts.

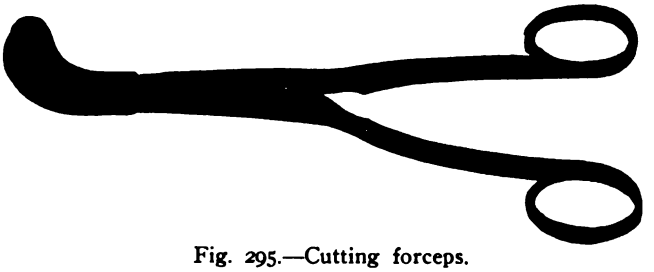

Fig. 295.—Cutting forceps.

ADENOIDS.

Under normal conditions the mucous membrane of the naso-pharynx is the seat of a considerable amount of lymphoid tissue which in some cases becomes markedly hypertrophied. This adenoid tissue is usually widely distributed over the roof and posterior wall of the naso-pharynx. It occurs as soft, irregular masses, which are very vascular, and bleed readily on contact. Between the masses of adenoid tissue there are furrows or foci which contain innumerable bacteria. The process is usually associated with enlarged tonsils and a chronic rhinitis. It occurs in children and especially in those of a strumous habit. It is said to be much more frequent in large cities than it is in the country.

In consequence of the pressure of these growths, or infection, the patency of the Eustachian tubes is often interfered with and some degree of deafness produced.

SYMPTOMS.—These are in the main due to interference with normal respiration. The naso-pharynx is often obstructed and the child is obliged to breathe through its mouth. Consequently the facial expression is usually characteristic. The mouth is half open and the alæ nasi are drawn in with each inspiration. The nose is pinched, and the facial expression is dull, heavy and listless. The child's mentality is interfered with, and it gets on

poorly at school. When asleep the child breathes with difficulty, snores loudly and often seems to choke. There is often a good deal of secretion in the naso-pharynx, which is hawked out with difficulty. The child's chest often becomes flattened in consequence of the difficulty of respiration.

If not treated, the condition is usually recovered from by atrophy of the adenoid tissue at or about adult age. This atrophy, however, is acquired at a great cost to the child in the way of physical and mental development.

DIAGNOSIS.—In addition to the symptoms already enumerated, the diagnosis is established by inserting the finger behind the soft palate into the naso-pharynx, when the soft, irregular masses of adenoid tissue will readily be felt.

TREATMENT.—In well-marked cases this consists of the removal of the adenoid tissue, which is done under an anæsthetic with instruments specially devised for the purpose. These instruments are usually cutting forceps and curettes bent about one inch from the extremity to a right angle (Figs. 295 and 296). The forceps are introduced behind the velum, and the soft and projecting tissue bitten away. The entire area of the naso-pharynx should be carefully gone over. The curette is then introduced and the posterior wall of the pharynx quite freely scraped. This should be followed by the introduction of the finger, in order that one may be sure that all of the hypertrophied tissue has been removed. There is very free

Fig. 296.—Curette

bleeding during the operation, but if the head is dependent the blood readily escapes from the nostrils. Following the operation the naso-pharynx should be gently washed out once or twice each day, with a mildly antiseptic solution. If the tonsils are enlarged they should be removed at the same sitting.

EPISTAXIS, OR BLEEDING FROM THE NOSE.

This is due to a variety of causes. The condition is very frequent at or about adult age. It may be the result of a traumatism, or cerebral congestion. It is frequently the result of a small ulcer situated on the septum. It may be due to tumors or foreign bodies situated within the nasal cavities. The bleeding is usually unilateral and from a vessel situated within the anterior nares.

TREATMENT.—In the attempt to arrest epistaxis the patient should be instructed to sit upright, and cold water or ice should be applied to the nape of the neck and the root of the nose. The bleeding very frequently being situated in the anterior nares, if the nostrils are firmly grasped and held for a few moments, the blood will clot in the nasal cavity implicated, and the hemorrhage will often be arrested. In all severe cases the anterior nares should be carefully examined with a nasal speculum and a headlight. If an ulcer in which there is a bleeding vessel is discovered, the vessel may be lightly touched with the point of a galvano-cautery, or the ulcer swabbed with a solution of chromic acid. Either of these measures is usually efficient in arresting bleeding. In cases in which the bleeding is excessive

therwise be controlled, the posterior and anterior nares may This may be done with a Bellocq's sound (Fig. 297), or by rong silk thread through an ordinary gum elastic catheter. gauze about one and one-half inches by one inch in size is

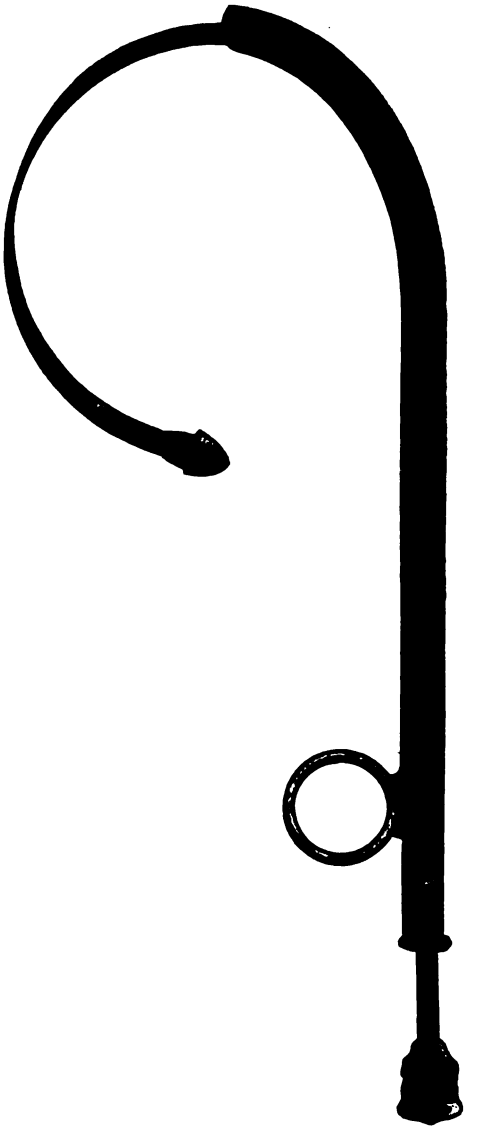

Fig. 297.—Bellocq's sound.

center with a strong silk thread. An additional silk thread ied to the pledget and be brought out of the mouth when the e, for the purpose of removing the gauze, when this is thought he sound is introduced through the nose and carried down ft palate into the mouth, to the end of the sound or to the

end of the thread within the catheter. The threads connecting with the pledget of gauze are attached and are drawn back through the nose, while the pledget of gauze is guided with the finger up against the naso-pharynx. The threads that come out of the nose are then tied securely about a second plug of gauze placed in the anterior nares. At the end of twelve hours the plugs are removed and the nostrils gently washed out with a mildly antiseptic solution.

GANGRENOUS STOMATITIS.

This condition is of rare occurrence, but occasionally is seen in children following a severe exanthematous disease. It may also occur in the course of a severe diabetes or albuminuria. It is usually associated with marked general debility. In pronounced cases large sloughs may occur on the inside of the mouth and in the cheeks. In fact, a considerable portion of a cheek is occasionally lost as a result of the process.

TREATMENT.—The general condition of the patient must be improved and the wound asepticized. The former is done by the administration of tonics and attention to the hygienic surroundings, and attention to the food. The wound is asepticized by curetting or cutting away all gangrenous sloughs and applying pure carbolic acid, followed by alcohol, to the disintegrating surfaces.

MERCURIAL STOMATITIS.

This condition may occur during the administration of mercury. Occasionally it is observed after the administration of a single dose, in persons peculiarly predisposed to the influence of the drug. It is increased by the continuance of mercury and by local irritants, such as excessive smoking.

SYMPTOMS.—The gums become swollen, very sensitive and bleed readily. The teeth are often loosened and about the teeth and from the borders of the gums there is a most profuse and offensive muco-purulent discharge. This discharge is often so excessive that it flows almost constantly from the mouth. In some cases the tongue is also markedly swollen. In consequence of the inflammation, tenderness and looseness of the teeth, the patient is unable to take hot fluids or eat hard food.

TREATMENT.—The amount of mercury taken should be diminished or withdrawn. The patient should be given internally and as a wash chlorate of potash, while the bowels are kept open with salines.

ALVEOLAR ABSCESS.

This condition is practically always associated with infection at the root of a tooth. The pus follows the root to the crown, where it forms a submucous abscess, or the pus is arrested beneath the periosteum and forms a subperiosteal abscess. In some cases it penetrates directly through the alveolus beneath the mucous membrane toward the cheek. The pus in these cases is situated between the maxillary bone and the skin. The tissues of the cheek become adherent to the jaw and finally the abscess opens externally, producing a sinus which leads by a more or less circuitous route to the root of the tooth. The process is attended with marked swelling of

the face, fever and considerable pain. As soon as fluctuation makes its appearance, the pain disappears.

The diagnosis is readily made. There is a loose and diseased tooth, with pain in the alveolar socket, followed by swelling and great tenderness of the gum, which finally fluctuates. The face upon the affected side is also swollen, and if the affected tooth is in the upper jaw very often the corresponding eye will be partially or completely closed. Swelling of the face with toothache is very characteristic of this affection.

TREATMENT.—This consists in freely incising the gum as soon as pus makes its appearance, or as soon as the swelling is pronounced. If the swelling is marked and fluctuation absent, and especially if the process is extending towards the cheek, a free incision should be made from inside the mouth down to the alveolar border, thoroughly dividing the periosteum for the purpose of giving vent to the infectious material and preventing it forming a sinus upon the face through the cheek. At the same time if the tooth is diseased it should be extracted.

TONGUE-TIE, OR SHORTNESS OF THE FRAENUM LINGUAE.

This is a congenital affection, and when marked binds the tongue down to the floor of the mouth and interferes with nursing and later with speech. The condition is readily recognized by placing the first and second

Fig. 298.—Grooved director. Tongue tie end.

fingers beneath the tip of the tongue and endeavoring to raise it. It will then be seen that the frænum is unduly short. The frænum is best exposed and made tense by pressing it into the slit end of a grooved director (Fig. 298). This makes the frænum prominent while it presses backward the vessels and tissues on either side of the tongue. The frænum is then divided by a pair of shears, curved on the flat, and in a direction backwards and downwards, care being taken not to wound the ranine vessels.

WOUNDS OF THE TONGUE.

Severe wounds of the tongue are frequent in childhood. During a fall the tongue is thrust out of the mouth, while the teeth are brought forcibly together, inflicting a severe wound upon the organ. The tongue is nearly always bitten during an epileptic seizure, but these wounds are usually not severe. In accidental wounds the tongue may be more than half severed. In severe wounds of the tongue the hemorrhage is quite pronounced.

TREATMENT.—The parts should be thoroughly cleansed and then brought together by interrupted sutures, which include all of the tissues cut. The sutures should be of silk and tied in three knots. Otherwise the knots may come untied in consequence of the child's constantly rubbing the tongue against the roof or sides of the mouth.

ACUTE PARENCHYMATOUS GLOSSITIS.

Acute inflammation of the tongue may arise from penetrating wounds, llowed by infection, the bites of insects, and from mercury. The process ay be confined to one-half of the tongue, or the entire organ may be imicated. The tongue becomes at times so much swollen that it fills, and en protrudes from, the mouth. Speech, deglutition and respiration are terfered with. The salivary glands are enlarged and there is a profuse w of saliva from the mouth. Diffuse or localized suppuration may occur.

TREATMENT.—If mercury is being used, it should be withdrawn, while tention is given to cleanliness, and chlorate of potash administered interally. If the process is due to infection, antisepsis should be practised. If elling is very pronounced, interfering markedly with deglutition and spiration, or if a local abscess occur, a free longitudinal incision through e dorsum of the tongue on one side of the median line should be made; if the tongue is greatly inflamed an incision may be made on each side the median line. There need be no fear of excessive hemorrhage from ese incisions, because the ranine vessels are placed beneath the tongue, here they are protected from any ordinary incision.

CHRONIC SUPERFICIAL GLOSSITIS.

This process may be due to syphilis and occur as a late manifestation. may be due to dram drinking, excessive smoking, and perhaps to dyspep-. The inflammation may be represented by enlarged and swollen papil- situated upon a hyperæmic base, by thickened patches of white and rny epithelium (leukoplaxia), by dense white patches scattered over the rsum of the tongue (ichthyosis), and by the occurrence of red glazed tches in which the papillæ are atrophied. This process may be circumribed and occur in patches, or the entire tongue may be glazed and red. some cases the organ is cracked, fissured and ulcerated. The median sure may run down the center of the tongue, with radiating fissures at e sides.

TREATMENT. The first consideration is to get rid of the cause. Smoking, chewing, dram drinking and the use of highly seasoned foods should interdicted. The teeth and mouth should be thoroughly and frequently nsed with some mild antiseptic. Once a day a four per cent solution argyrol may be brushed over the sensitive surfaces with advantage. If e process is due to syphilis, iodide of potash should be administered. Mild ics are often necessary.

ULCERS UPON THE TONGUE.

Ulcers which occur upon the tongue may be divided into simple, tuber- syphilitic and epitheliomatous. The simple ulcer is usually the result a traumatism and often occurs from a jagged tooth. It may be situated on the two borders or dorsum of the tongue. It is usually small, well cir- [illegible] and without more than inflammatory indu- [illegible] and relieved from [illegible] a few days.

TUBERCULAR ULCER.

This is usually single and situated upon the tip or border of the tongue. It is a chronic ulcer, usually round, slightly indurated at its base, covered with small, pale granulations, and occurs perhaps more especially as a secondary process in persons advanced in years, and in those who are the subjects of tubercular processes in their lungs or larynx. The ulcer is quite painful, extends very slowly, and will not heal under any ordinary treatment. The patient is usually in a cachectic condition, pale and thin in flesh.

TREATMENT.—The tubercular ulcer should be freely excised. Possibly in some cases it may for a time be treated with the X-ray.

SYPHILITIC ULCER.

This may be represented by the primary chancre which may occur upon the tip of the tongue in young people. The ulcer is cup-shaped, covered often with a thin membrane, and has a very hard, indurated base. The submental lymphatic glands are usually enlarged. The ulcer readily heals under specific treatment. In the secondary stages of syphilis, tuberculous fissures and ulcers occur upon the edge and borders of the tongue. They are quite chronic in their course and are not specially painful. Their base is distinctly indurated and they will not heal except under specific treatment.

GUMMATA.

During the late tertiary stage gummata may make their appearance beneath the dorsum of the tongue. They are usually multiple and occur as quite large submucous indurations. Later these gummata break down and produce large, deeply excavated ulcers, with ragged edges. The contents of a gumma is discharged much as would be a boil. The base and borders of such an ulcer are not markedly indurated, nor specially sensitive. The ulcer will not heal except under antisyphilitic treatment.

EPITHELIOMATOUS ULCER.

This is a progressive, slightly excavated, ragged ulcer, usually situated upon the border of the tongue in persons over 50 years of age. It is the site of very severe pain. The submaxillary glands are enlarged, the movements of the tongue are painful and often restricted, the patient loses flesh and becomes cachectic.

TREATMENT.—The treatment of an epithelioma of the tongue is that of free excision.

DIFFERENTIAL DIAGNOSIS OF ULCERS OCCURRING UPON THE TONGUE.

The simple ulcer is usually due to a traumatism, is small, single, with little induration at its base, and heals inside of a week or ten days if protected from injury and infection.

The tubercular ulcer occurs, as a rule, in patients past 50 years of age. It may be secondary to tubercular processes elsewhere. The patient is usually cachectic, often weak and anæmic. The ulcer is very painful, slowly progressive, its base is slightly indurated and covered with flabby, light-colored granulations. The ulcer will not heal under any ordinary treat-

The primary chancre occurs upon the tip of the tongue in young persons, is covered by a thin, grayish-white film, is not specially painful, and its base is excessively hard. It readily heals under antisyphilitic treatment.

The gummatous ulcer follows the breaking down of a gumma in the tertiary stage of syphilis. It is not specially indurated, but has ragged edges and is deeply excavated. There will usually have been a history of syphilis and the ulcer will heal under antisyphilitic treatment.

The epitheliomatous ulcer occurs in patients past 50, is usually at the border of the tongue, is single, has a hard base, is slightly excavated, markedly progressive and the surface is often covered with sloughs and necrotic tissue. It is excessively painful. The submaxillary glands are enlarged. The ulcer will not heal under any ordinary method of treatment.

PAROTITIS (MUMPS).

This is an infectious and contagious disease, characterized by inflammation of the parotid glands. The disease often affects children. Infants and adults are usually exempt. The disease occurs in epidemic form and occasionally is endemic in certain localities. Three or four days following the occurrence of inflammation in one gland, the second gland ordinarily becomes involved. The disease is most frequent in the spring and autumn, and attacks boys more frequently than girls. The nature of the contagion is not known. Parotitis occasionally occurs as the result of traumatism, and is known to follow abdominal operations and diseases, especially those of a suppurative character. In these cases it is probably due to pyogenic infection. Pyogenic infection may also occur through Stenson's duct from the mouth.

Symptoms. The period of incubation is from two to three weeks. The disease manifests itself by fever, pain and swelling about the ear. In two or three days the swelling is pronounced and extends in front of, beneath and behind the ear, and beneath the sterno-cleido-mastoid muscle. The swollen gland is very tender and there is an inability to open the mouth. Deglutition is difficult. There is often earache and there may be otitis media, with impaired hearing. In ordinary cases the inflammation runs its course in about a week. Suppuration is rare. In very severe cases high fever, delirium and prostration may mark the course of the infection. In some cases, although these are rare, the process ends in death.

Complications. Orchitis occurs in boys in about one-third of the cases. In girls, ovaritis, mastitis and vulvo-vaginitis may occur. Atrophy of the testicle may follow the inflammation, and if both testicles become involved sterility may result. Meningitis, arthritis, albuminuria, uræmia and convulsions are also occasional complications.

Diagnosis. The swelling in front of and beneath the ear, with fever, the patient being a child and there being no other assignable cause, is sufficient ordinarily for diagnostic purposes.

Treatment. Warm applications are comforting to the patient. A little hot oil may be applied over the swelling, and the side of the head and neck enveloped in absorbent cotton, covered with oiled silk and held in place by a bandage. If the swelling is very severe and the fever high,

an icebag may be applied. In very severe cases, with redness and gr tenderness, leeches may be used with advantage. The bowels should open and the child kept in bed. Suppuration is rarely to be feared. If t pain is very severe an opiate may be administered. For the orchitis, supp and compression with a lead and opium wash are serviceable. In paroti due to infection and progressing to suppuration, a free incision should made through the superficial soft parts, and the pus cavity located w a grooved director. A pair of rather pointed artery forceps may then pushed along the groove into the abscess cavity, opened and withdra

Fig. 299.—Cleft confined to soft palate.

while open (Hilton's method). A drainage tube should then be introdu and the cavity washed out, free provision being made for drainage.

CLEFT PALATE.

By this is meant a congenital defect of development in conseque of which the structures entering into the formation of the roof of mouth do not coalesce, with the result that an abnormal communicat exists between the mouth and the nasal cavities. The cleft may be confi to the soft palate (Fig. 299), or include the horizontal plate of the pal

bone, or the major portion of the palate process of the superior maxillary (Fig. 300). In extreme cases the cleft passes through the alveolar border and is associated with hare-lip. The cleft is usually in the median line, although anteriorly, when implicating the alveolar border and complicated with hare-lip, it is situated between the fronto-nasal process and the palate process of the superior maxillary bone.

In consequence of the deformity, the power of suction and swallowing are often interfered with, and consequently nutrition is impaired. In consequence of the absence of the floor of the nose, liquids and solids enter the

Fig. 300.—Cleft through soft and hard palate.

naso-pharynx and cause a catarrhal inflammation. Taste and smell are also interfered with.

The most serious defect, however, is that of speech. The voice has a peculiar monotonous twang which is very distressing. The child is unable to articulate distinctly, and often only those with whom it is more or less constantly associated can understand it. The letters known as explosives are incapable of articulation.

The most suitable age for an operation is from the third to the sixth year, although some surgeons advocate operating during the first year,

while others defer the operation until from the eighth to the tenth year. The general health should be good and the naso-pharynx reasonably free from catarrhal disease.

TREATMENT.—The requisites for a successful operation are, first, to have the naso-pharynx in a reasonably healthy condition; second, to thoroughly pare the edges of the cleft so that there will be reasonably broad

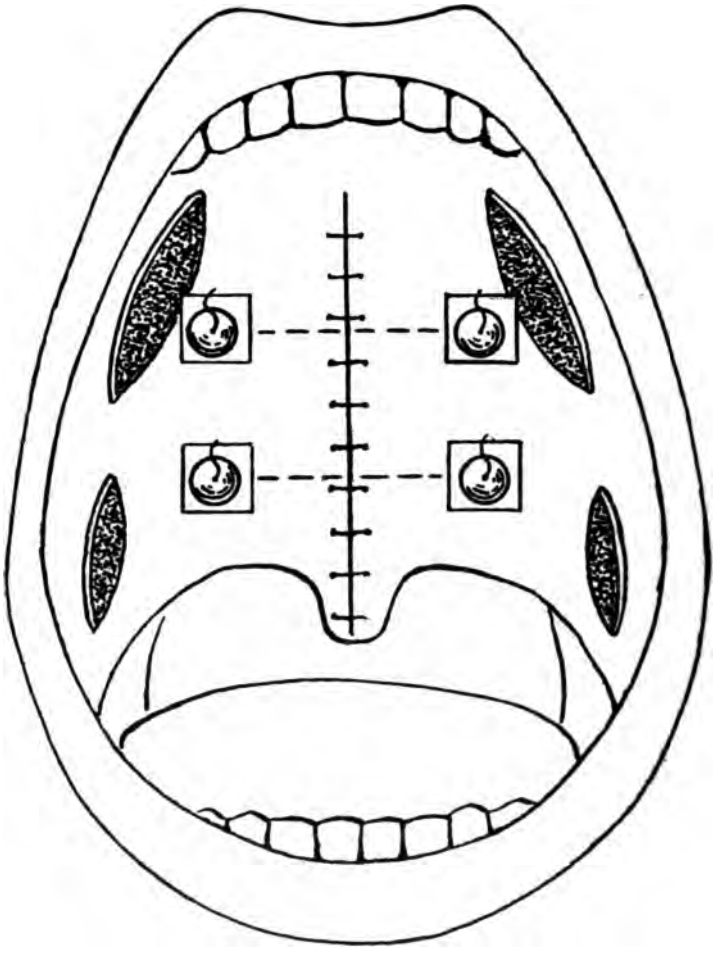

Fig. 301.—Operation for closure of cleft through soft and hard palate.

surfaces to coapt; third, to evenly and accurately unite the denuded surfaces without tension; fourth, to do as little injury to the parts as possible during the operation; fifth, to maintain the parts after the operation in a quiescent and perfectly clean condition.

The operation for a cleft in the soft palate is comparatively simple. The edges are freely pared and brought together by two sets of sutures; first, the relaxation sutures, two in number, which are passed through the

soft palate at a considerable distance from the freshened border, and which consist of silver wire with shields and shot; and second, the coaptation sutures of silk or other suitable material. When the parts have been approximated all tension should be relieved by lateral incisions.

In operations for the closure of clefts which implicate the hard palate as well as the soft, after paring the edges of the cleft incisions are made near to and conforming in direction with the alveolar borders, and down to the bone. A small bent periosteal elevator is then introduced into one of these incisions and the muco-periosteal covering stripped from the bone. This process is then carried out upon the opposite side. The purpose of the stripping up of the muco-periosteum is that the denuded edges may be brought together in the median line. They are then united as before with relaxation sutures, consisting of shields and shotted silver wire, and coaptation sutures of silk. The tension is relieved by lateral incision. The difficulties of the operation are the small space in which to work, the hemorrhage, and the proper placing of the sutures (Fig. 301).

ACUTE FOLLICULAR TONSILLITIS.

This disease occurs most frequently in young persons, apparently as the result of exposure to wet and cold, the effects of sewer gas, and bad hygienic surroundings. The occurrence of tonsillitis predisposes the patient to subsequent attacks. As etiological factors the streptococcus, staphylococcus and bacillus of diphtheria are often active. Tonsillitis is thought by many to have some relation to acute articular rheumatism and to chorea. It is often the precursor of endocarditis and erythema nodosum. Acute tonsillitis is most prevalent in the spring and fall.

The lacunæ of the tonsils become filled with the products of inflammation, which have the appearance of whitish, curd-like masses. These curd-like masses may coalesce and produce patches which resemble those of diphtheria. The tonsils are swollen and of a bright red color.

Symptoms.—Slight chilly sensations, with aching pains throughout the back and general system, are likely to precede the tonsillar inflammation. The fever then rises rapidly and may reach 104 or 105 degrees F. There is pain in the throat, with difficulty of swallowing. Respiration is also interfered with, the circulation becomes rapid, the face flushed and the urine scanty. As the swelling progresses, there is very great pain in swallowing and the patients even insist that they are unable to swallow even a spoonful of water. The cervical glands become swollen. As a rule in three or four days after the onset of the inflammation in one tonsil, the other becomes involved. Earache is frequent and involvement of the middle ear occasionally occurs.

The process usually runs its course in each tonsil in from six to seve[illegible] days.

Diagnosis.—There may be difficulty in differentiating follicular to[illegible]sillitis from diphtheria. In follicular tonsillitis the [illegible] exudate are confined to the tonsils, are usua[illegible] with a swab without leaving a bleedin[illegible] diphtheria

ACUTE SUPPURATIVE TONSILLITIS.

In some persons nearly every attack of tonsillitis is followed by suppuration. The pus forms in the upper part of the tonsil and extends to the soft palate. In these cases the etiological factor is the presence of one or more of the pyogenic germs. In suppurative cases the fever runs high, the pain is very severe, while prostration is marked in consequence of the pain, high fever, inability to sleep or take nourishment. In these cases in from four to six days after the onset the tonsil and soft palate become enormously swollen and fluctuation is sometimes to be detected.

TREATMENT.—In follicular tonsillitis aconite and the salicylates may be given internally with advantage. Mild antiseptic mouth washes should be used. The neck may be enveloped in absorbent cotton and a flannel bandage. If the pain and swelling are severe, cold may be applied. If suppuration is impending, heat is most agreeable. If pus is present a free incision should be made in the upper part of the tonsil. This should be followed by a warm gargle composed of some mildly antiseptic solution. An incision into the tonsil should not be made unless one is practically certain that pus is present, because without pus an incision aggravates the inflammation and increases the swelling by affording new foci for infection. Persons who suffer from recurrent tonsillitis should have their tonsils removed and naso-pharynx carefully treated.

CHRONIC TONSILLITIS.

This condition often occurs in strumous patients, especially in children whose lymphatic tissues are markedly hypertrophied. The process may follow diphtheria or follicular tonsillitis. It is probably due in many cases to a mild degree of pyogenic infection.

As a rule all of the constituents of the glands are in a state of hypertrophy. In some cases the tonsils are soft and the lymphoid tissue is in excess; while in others the tonsils are hard and the fibrous tissue is the part which has taken on marked hypertrophy.

SYMPTOMS.—The tonsils are enlarged and often meet in the median line. They are pale and non-sensitive. There is interference with respiration, especially at night, when the child snores and seems to choke. Children with enlarged tonsils keep the mouth half open and even then find some difficulty in breathing.

TREATMENT.—The general health should be improved by correcting the hygienic surroundings, giving cold sponge baths in the morning and administering tonics. If the tonsils are not large they may be painted with tincture of iodine once or twice a week, and the naso-pharynx kept clean, or they may be treated with a galvano-cautery. If the tonsils are large and show no disposition to decrease in size, and if they interfere with respiration and cause difficulty of breathing at night, or jeopardize the health and well-being of the patient, they should be removed.

Technic.—The child is placed in a sitting position before a good light, the naso-pharynx thoroughly cleansed, and the tonsil swabbed over with a four per cent solution of eucain or cocain. The mouth is then widely opened and the tonsilotome introduced so that the tonsil becomes pressed into and through the ring. Pressure at the angle of the jaw makes

the tonsil prominent and the process easier. When once the tonsil is well within the ring of the guillotine, the tonsil is removed by one stroke of the instrument (Fig. 272). The hemorrhage is usually quite free for a few moments, and then gradually ceases. In rare cases it is excessive and perhaps then often due to the removal of too much of the tonsil, or a removal of a portion of the soft palate. If the bleeding seems to be excessive and not readily controlled by hot water or ice, pressure may be made directly upon the bleeding point by the tip of the finger placed in the mouth.

If both tonsils are enlarged, they may be removed at the same sitting. sitting.

CONGENITAL MALFORMATIONS OF THE ESOPHAGUS.

A congenital communication sometimes exists between the œsophagus and trachea, with the upper end of the œsophagus either open or closed. A congenital stricture may also be present near the cardiac extremity of the œsophagus. These malformations are inimical to life.

ACQUIRED MALFORMATIONS.

These occur in the form of diverticula. These are of two forms, one, due to pressure and probably congenital weakness of the walls of the œsophagus and situated upon its posterior wall and extending into the neck or chest. This diverticulum may reach the size of a child's or adult's head.

The symptoms are due to the pressure of the sac upon the adjacent structures. The sac becomes filled with food which putrefies and if the sac is in the neck it can be emptied by pressure. The person becomes weak and greatly emaciated in consequence of the inability to receive proper nutrition.

TREATMENT. If the sac is accessible it may be excised and the opening in the œsophagus closed by catgut suture.

The most frequent form of diverticulum is due to stricture at or near the lower end of the œsophagus. In consequence of the stricture the food fails to enter the stomach and becoming arrested in the œsophagus causes its dilatation and a chronic œsophagitis.

SYMPTOMS. The symptoms are usually those indicative of a stricture. The patient is able to swallow a quantity of liquid which in a few moments is regurgitated almost as taken.

TREATMENT. This consists in the dilatation of the stricture, if this is possible, the administration of strychnia, and the resort to rectal feeding.

FOREIGN BODIES.

Foreign bodies such as fish bones, plates of teeth, pieces of food, coins and pins, occasionally become lodged in the œsophagus. Their lodgement is followed by severe pain beneath the sternum, the feeling as if something heavy was lodged in the œsophagus, and an inability to swallow even liquids in any considerable quantity. Respiration may be interfered with, and at times when a foreign body becomes tightly impacted at the entrance of the œsophagus, death is prod[illegible] dyspnœa. If the impaction is not so tight, œdema of [illegible]n of the walls of the

œsophagus may occur. Koenig states that about fifty per cent. of the foreign bodies which become lodged in the œsophagus are spontaneously passed on into the stomach, or back into the mouth.

TREATMENT.—The method of treatment of foreign bodies lodged in the œsophagus will depend in a measure upon their location and nature. Foreign bodies situated in the upper portion of the œsophagus may be removed with suitable forceps, or with an expanding probang, which is passed by the body while closed, and then expanded and withdrawn, sweeping out, as it were, the œsophagus and bringing the foreign body with it (Fig. 302). If the foreign body is soft it may at times be pushed with a sponge probang down into the stomach. If it is large or cannot be removed by these measures, it should be cut down upon and removed (œsophagotomy). An incision four inches long is made on the left side and along the anterior border of the sterno-mastoid muscle. The platysma and

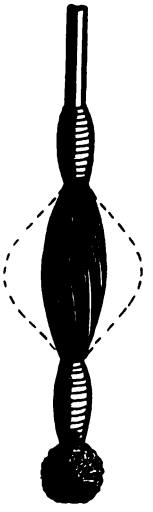

Fig. 302.—Probang for removing foreign bodies from the esophagus.

deep fascia are divided, the sterno-mastoid drawn outward, the omohyoid divided, and a blunt dissection made, with the carotid sheath on the outer side and the trachea and pharynx on the inner. During this dissection the thyroid vessels are avoided, the wound is deepened until the projection of the foreign body in the œsophagus is felt. The œsophagus is then opened and the foreign body extracted. If the body is situated below the top of the sternum the incision is made low down, and after opening the œsophagus an effort is made with suitable forceps to extract the foreign body. After extraction the mucous membrane is sutured with catgut and the remainder of the wound lightly packed with iodoform gauze.

Foreign bodies impacted near the cardiac end of the œsophagus may be removed by opening the stomach, and dilating the cardiac extremity [illegible] then removing the body; or the same result may be accomplished at [illegible] by passing a small catheter or probang which has attached to it a [illegible] silk thread, and at the end of the thread a sponge of suitable size.

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The probang is passed from the stomach into the mouth, and then v drawn, the thread dragging the sponge through the œsophagus and it the foreign body.

INFLAMMATION OF THE ESOPHAGUS.

This may be caused by the passage or retention of a foreign b by the drinking of corrosive liquids. The symptoms are pain and di of deglutition and at times the vomiting of blood-stained mucus. treatment consists in rectal feeding or the restriction of mouth fo the blandest of fluids, and the application of moist heat to the regi sternum.

SPASMS OF THE ESOPHAGUS (ESOPHAGISMUS).

This condition is most frequently met with in young, hyster but may also occur in men suffering from hypochondriasis. Th plaint of an inability to swallow, usually accompanied with the sternum.

The diagnosis is made from the symptoms, and these sh or neurotic condition of the patient, and an apparent inabili even liquids, and by the passage of a good-sized œsophageal readily goes into the stomach. The condition must be carefu ed from benign and malignant strictures.

The treatment is confined very largely to the relief of t neurotic condition of the patient. Tonics, cold baths a usually called for.

ORGANIC STRICTURE OF THE ESOPHAGUS

This is of two kinds, benign, or fibrous, and malign.

The fibrous structure may be the result of the hea caused by the impaction of a foreign body within the e result of the healing of a syphilitic ulcer. The primary is most frequently caused by the swallowing of a corr cially the accidental drinking of lye. The fluid causes a p of the mucous membrane of the œsophagus, which on sloug a large ulcer. This in healing leads to cicatricial contract stricture. The stricture is most frequently situated in the just behind the cricoid cartilage.

SYMPTOMS.—These usually make their appearance sev the drinking of the fluid. At first it is difficult and after to swallow solid foods, and this again is followed by an in liquids, except very slowly and in small quantities; an perhaps months, the patient is practically unable to swal The patient may be able to swallow food in cases of ev and to drink a half a glass of water or other fluid. This dilated œsophagus above the stricture for a few mor regurgitated. In consequence of the inability to take f comes greatly emaciated and very much weakened.

The diagnosis is readily made by a consideration the symptoms, and if necessary the use of an œsophage

TREATMENT.—These cases, occurring as they do very frequently in children, the dilatation of the stricture is often attended with a great deal of difficulty, and requires much patience and perseverance. The methods of dilatation of the œsophageal stricture are much the same as those of an urethral stricture. The patient, if a child, should be seated before a window, its head and arms held and its mouth gagged open. The base of the tongue is then depressed with the left finger, and in order to determine the location of the stricture a No. 8 or 10 bougie is passed through the pharynx into the œsophagus. This will readily determine the situation of the stricture. If the stricture is very tight, one commences with No. 1 bougies or with filiform whalebone bougies. One or more of these are passed into the œsophagus and an effort made with gentleness and care to pass the stricture. In any case where the stricture is tight it may require several sittings before the smallest bougie can be made to pass into the stomach. When one succeeds the bougie should be left within the œsophagus for ten or fifteen minutes if possible, so that it will dilate to some extent the stricture. Then it is withdrawn and one of larger size introduced, which is left in position for ten or fifteen minutes. Then the patient may be dismissed, and upon the following day a No. 2 or 3 English bougie may be introduced and the size gradually increased from day to day until one reaches a No. 8 or 10 bougie. From this on some little force may be used, and, as a rule, the stricture readily dilated up to No. 12 or 15 English. Following full dilatation the patient should return for treatment at first once a week and then once a month for the first year. During these visits the œsophagus is again fully dilated.

MALIGNANT STRICTURE (EPITHELIOMA).

Malignant stricture in the œsophagus is usually situated in its lower portion, near or at the cardiac extremity of the stomach. It may, however, be situated at its commencement, or behind the cricoid cartilage, or in the middle portion where crossed by the left bronchus. The growth usually involves the whole circumference of the tube. Ulceration follows and perhaps perforation of the œsophagus, trachea, pleura or one of the large blood vessels. The glands in the neck or posterior mediastinum are often enlarged. Visceral complications may occur. Malignant stricture of the œsophagus is most frequently found in men who have passed their fiftieth year.

SYMPTOMS.—The symptoms correspond very closely with those of benign stricture. There is, however, more pain and greater emaciation, with more marked weakness. There is the same increasing difficulty in swallowing solid foods, and finally difficulty and perhaps inability to swallow even liquids.

The diagnosis is made by considering the age of the patient, the history of the case, and by the use of an œsophageal bougie.

TREATMENT.—Under ordinary conditions there should be no attempt made to dilate what seems to be a cancerous stricture of the œsophagus. The reason for this is two-fold: First, a cancerous stricture cannot be maintained open after it has once closed by any method of ordinary dilatation; and second, there is great liability of making a false passage in

called specific serum prepared by Drs. Beebe and Rogers has also been used. This is made by grinding the thyroids of exophthalmic goitres, precipitating the neucleo-proteids, globulins and thyroglobulins, and then injecting these precipitates either in the fresh or dried state into rabbits for a period of five weeks, following which the rabbits are bled to death and the serum injected in doses of from 15 to 30 minims into the patient suffering from exophthalmic goitre. Ten cases were treated with this serum, with the result that three were cured, three greatly improved, while the remaining four were only slightly benefited.

Surgical Treatment.—At the present time the surgical treatment of exophthalmic goitre consists in the removal of one-half of the gland, or the removal of the cervical sympathetic ganglia in the neck. The quite prevalent opinion being that the disease is due to a hypersecretion of the enlarged thyroid gland, the majority of operators resort to the excision of one-half of the gland, rather than to the removal of the cervical sympathetic ganglia. The removal of one-half of the gland is not without risk, and is not always curative. In Kümmell's cases, 70 per cent. were cured, while 5 per cent. died as a result of the operation. These results may be considered very favorable. Cases in which there is an excessively dilated and hypertrophied heart should not be subjected to operation.

Following an operation a severe condition of thyroidism may occur, in which the patients become excessively restless, even delirious, while the pulse becomes practically uncountable. From this condition the patient may succumb. It is, however, often readily controlled by the administration of morphine. The operation when successful reduces, either immediately or within a few months, the pulse from 20 to 50 beats per minute. The extent of the benefit is often not reached for several months following the operation. The operation is to be recommended in all suitable cases.

CELLULITIS OF THE NECK.

This may be superficial or deep. The superficial form of inflammation implicates the structures external to the deep cervical fascia; while the deep form has its origin in the tissues beneath the deep cervical fascia. Superficial cellulitis may be due to cold, injury, open wounds or to one of the infectious diseases. The deep form is usually due to some local infection in the mouth, as in the tonsils, about the teeth, or in the submaxillary gland.

The symptoms of superficial cellulitis are swelling and induration beneath the skin, which may be reasonably localized, or diffuse, with pain, redness of the skin and fever. The process may go on to pus formation, or resolution may take place.

The treatment should consist primarily of rest, the application of cold or warm antiseptic compresses, the latter being wrung out of a warm carbolized solution. The bowels should be freely opened. If the fever continues and pus forms, a free incision should be made over the center of the indurated area, keeping in mind the position of the external jugular vein. If a punctured wound has been the focus of infection, this should be freely enlarged, asepticized and drained. After freely opening the area of infection, compresses of sterilized gauze, wrung out of a hot carbolized solution,

should be frequently applied, and covered by some impervious material; the compresses will then retain their heat and moisture for a considerable time.

DEEP CELLULITIS OF THE NECK.

In this process there will have been an infection of some of the deeper structures within the neck or mouth, which has spread through the lymphatics or by continuity of structure to the deep cellular tissues. In this form there is a hard, brawny induration, with pronounced swelling, extending over the side of the neck. The inflammation usually rapidly progresses. The neck is stiff, there is inability to open the mouth to any extent, with difficulty of deglutition, and often marked dyspnœa. At times there are attacks of impending suffocation from pressure upon the larynx. There is severe pain, inability to sleep, high fever, often chills, great prostration, and usually profuse perspiration. If pus forms, as is usual, it is held down by the deep cervical fascia and may make fatal pressure upon the larynx or trachea, or rupture into the trachea and suffocate the patient.

TREATMENT.—As the pus is beneath the deep cervical fascia fluctuation or softening of the brawny induration does not occur and must not be waited for. As soon as it is apparent that the process is progressive, in spite of local treatment, a free longitudinal incision should be made over the center of the induration, and through the skin, superficial fascia, and platysma. The pus is then sought for by thrusting a curved director or closed pair of pointed artery forceps into the inflamed area, following the method of Hilton. If pus is not encountered at the first thrust of the director, it is withdrawn and introduced in a different direction, keeping in mind the situation of the deep vessels. The pus having been located, the track of the director is enlarged by passing along the groove a pair of closed artery forceps. These, after reaching the abscess cavity, are opened and withdrawn while open, tearing a considerable space in the external tissues. A drainage tube should then be introduced and the parts kept clean.

FOREIGN BODIES IN THE AIR PASSAGES.

In attempting to bolt one's food a large mass may become lodged at the rima glottidis and produce complete obstruction, the person becoming black in the face and even falling dead. The same condition has occurred in attempts to swallow large foreign substances. If impaction is not complete, great dyspnœa is caused, with an inability to swallow. The same condition may occur during anæsthesia if the stomach is not empty, or a plate of teeth may be dislodged from the mouth and become arrested at the entrance of the œsophagus.

TREATMENT.—This in severe cases to be of any avail must be carried out at once. The mouth should be forced open with the handle of a large spoon, knife or fork, and the finger thrust into the throat and swept around the pharynx so as to dislodge any foreign substance. If this does not succeed, an incision may be made directly into the larynx, without preparation, and with one sweep of the knife. The lateral walls of the larynx should then be held open and artificial respiration practised. In less urgent cases the foreign body may be located with the finger or laryngoscope and removed with a pair of suitable forceps, or by the finger.

FOREIGN BODIES IN THE LARYNX.

A foreign body of small size held between the teeth may enter the larynx during a deep, sudden, and, as it were, unexpected, inspiration. The foreign bodies most apt to enter the larynx are pieces of nut shells, or nuts, toothpicks, coins, buttons and small tooth plates. As soon as the body enters the larynx there is induced a violent fit of coughing, with marked dyspnœa and a sense of impending suffocation. While the paroxysm lasts the face is puffed, swollen and cyanosed, the distress is intense and the voice croupy and hoarse. In a short time if the obstruction is not pronounced the paroxysm ceases, the person breathes more quietly and is more at ease, the larynx becoming, as it were, in a measure accustomed to the foreign body. The paroxysms of coughing, however, recur at longer or shorter intervals. They are very distressing and are excited by attempts to speak or to take food, or by undue exertion. If the foreign body is allowed to remain it is likely to produce laryngitis, tracheitis or bronchitis, depending upon its situation, and the inflammatory process is quite apt to be followed by ulceration and even abscess formation. A foreign body lodged in the larynx, trachea or bronchus, is not infrequently expelled during a severe paroxysm of coughing.

TREATMENT.—Foreign bodies situated in the larynx may at times be extracted with a pair of proper forceps and by the aid of the laryngoscope. Foreign bodies situated in the larynx, trachea or bronchus, if not impacted, are often readily expelled through the wound during a paroxysm of coughing and following a tracheotomy, the edges of the wound being held quite wide open by the aid of wire retractors. If not immediately expelled they may be some days after the operation. If not expelled at the time of the operation, they should be sought after with a pair of long and suitably curved forceps. Foreign bodies composed of metal are readily located now by the aid of the radiograph. Foreign bodies situated in a bronchus have been successfully removed by the bronchoscope. Under ordinary conditions it is very desirable to remove a foreign body situated within the air passage before it has done serious or irreparable mischief. They may cause localized ulceration and infection, with the formation of an abscess which may reach the costal pleura, and be incised and drained, the foreign body being expelled with the pus.

INJURIES OF THE LARYNX AND HYOID BONE.

As the result of direct violence a severe injury or fracture may occur to the larynx or hyoid bone.

SYMPTOMS.—With fracture there is likely to be some displacement and consequently deformity. Fractures are often compound internally and are consequently attended with hemorrhage. There will be localized pain, increased by any movements of the neck, difficulty in inspiration and often inability to swallow. In some cases the swelling is so severe that respiration is seriously interfered with and suffocation made imminent.

TREATMENT.—This consists in correcting any deformity which may be present, and then applying cold to the parts for the purpose of preventing or arresting inflammatory swelling. If there is a local external wound, this

should be asepticized and kept clean. If the swelling becomes great, so as to seriously interfere with respiration, a tracheotomy should be performed.

OPERATIONS ON THE AIR PASSAGES.

TRANS-HYOID PHARYNGOTOMY.

This operation is performed by making a vertical incision from the chin to the thyroid cartilage. The hyoid bone is divided in the middle line. The incision opens the pharynx and exposes the back of the tongue, the posterior wall of the pharynx and the upper part of the larynx. The operation is of service in the removal of growths from the epiglottis, posterior wall of the pharynx, base of the tongue and upper larynx. In this operation the pharynx must be entered through the lower part of the incision. In the removal of tumors from the pharynx a previous tracheotomy should be done, a large tracheal tube introduced and the upper portion of the trachea plugged, if there is likely to be any considerable hemorrhage. This procedure will prevent the blood entering the trachea.

THYROTOMY.

This consists in a partial or complete vertical incision through the thyroid cartilage. The operation is done for the removal of tumors within the larynx. A previous tracheotomy should be done, a large cannula introduced, and the upper portion of the trachea plugged. An incision is then made in the median line from the hyoid bone to the cricoid cartilage. The incision is deepened down to the thyroid cartilage, and the thyro-cricoid membrane incised. A small artery may be here encountered, but it is readily controlled with artery forceps. The thyroid cartilage is then divided in the median line with a pair of sharp bone forceps. The lateral halves are separated and the growth removed. After the removal of the growth and the arrest of hemorrhage, the thyroid cartilages are evenly and accurately reunited in the median line with chromicized cat-gut sutures. The superficial part of the wound is closed with silkworm-gut. The tracheal tube may be removed immediately or left in position for a day or two, according to the indications.

TRACHEOTOMY.

From six to ten rings of the trachea are situated above the sternum. The isthmus of the thyroid gland crosses the third and fourth tracheal rings. The trachea may be opened either above or below the isthmus. The mortality of the high operation is considerably less than that of the low. The low operation, however, is to be preferred in cases of membraneous croup, and in case of a foreign body situated in the trachea or bronchus. The upper portion of the trachea is much more superficial than the lower, as this organ recedes from the surface quite rapidly from its commencement to the top of the sternum.

High Operation.—The child is anæsthetized, the head extended and a hard block pillow placed under the back of the neck. An incision is then made from the top of the cricoid cartilage downward for about an inch and a half, or two inches, the skin and superficial fascia are divided, the sterno-

hyoid muscles identified and held apart, the isthmus which will be in the lower angle of the wound is dragged downwards with a dull retractor; and as the incision is deepened with the handle of the scalpel the trachea is identified by the finger, and finally by sight. The front of the trachea should be exposed above the isthmus, completely freed of tissues, fixed with a tenaculum which is strongly hooked into it on one side, and then incised from below upwards by entering the trachea, in the median line, with a thin, pointed knife. Ordinarily but two or three rings of the trachea are divided, but the incision may be extended upwards as far as deemed advisable. As soon as the trachea is opened a violent paroxysm of coughing will occur, with the forcible expulsion of blood and mucus. It is well now to open the tracheal wound widely, either with a tenaculum in the opposite side, or by placing within the incision a dull retractor, then a large tracheal tube should be introduced. The tracheal tube may be dispensed with and the incision within the trachea held wide open by passing silk sutures through the border of the trachea and tying these behind the neck, or by inserting suitable curved wire retractors within the incision in the trachea.

Low Operation.—In the low operation an incision is made in the median line from the cricoid cartilage to the top of the sternum. The skin, superficial and deep fascia are divided, and the muscles identified and separated. Some considerable venous hemorrhage may occur, but this is readily controlled by forceps pressure. The incision is gradually deepened by blunt dissection and the trachea identified by the finger.

The tissues below near the top of the sternum are retracted downwards and the isthmus drawn upwards, the trachea freed, fully exposed, fixed with a tenaculum and divided from below upwards. An incision of half an inch or more if thought necessary can readily be made in the trachea through the low operation.

Dangers of Tracheotomy.—The operation is not easy in fat, short, thick-necked children in whom respiration is labored and all the tissues engorged. In these cases but very little anæsthetic should be administered. In order to make the operation as easy as possible the incision should be rather long and made exactly in the median line. After the skin and fascia have been divided much of the dissection can be done with the handle of the scalpel. The anterior thyroid veins sometimes are quite prominent, and if divided may bleed quite freely and obscure the field of operation. If injured they should be immediately seized with the artery forceps. One should also bear in mind the position of the left innominate vein which crosses the trachea at or just below the top of the sternum. The inferior thyroid plexus may also give trouble, but ordinarily the bleeding is readily controlled. It is of great importance to fix the trachea before it is opened, so that it is directly under the surgeon's control, and then the cannula, if one is to be introduced, should be inserted as soon as possible after the trachea has been opened. Ordinarily, as the trachea is opened and the cannula is inserted the bleeding in consequence of the re-establishment of the respiration, becomes much less, or ceases entirely.

The cannula is held in position by tapes which pass about the neck and are secured behind.

Following a tracheotomy the wound and cannula, if one is inserted, ld be kept covered by one or more thicknesses of sterilized gauze. It is well to wring this gauze out of a hot carbolized solution. The gauze ld be frequently changed; the room should be kept warm and drafts ded. The nurse should change the internal tube and cleanse it in a warm olized solution every two or three hours. The tracheal tube should be oved as soon as the conditions for which it was inserted are overcome. ne little difficulty may be experienced during the first few days in nour- ng the child. Rectal enemata may be administered, but the child very n learns to take liquids by the mouth. They should at first be admin- ered in teaspoonful doses.

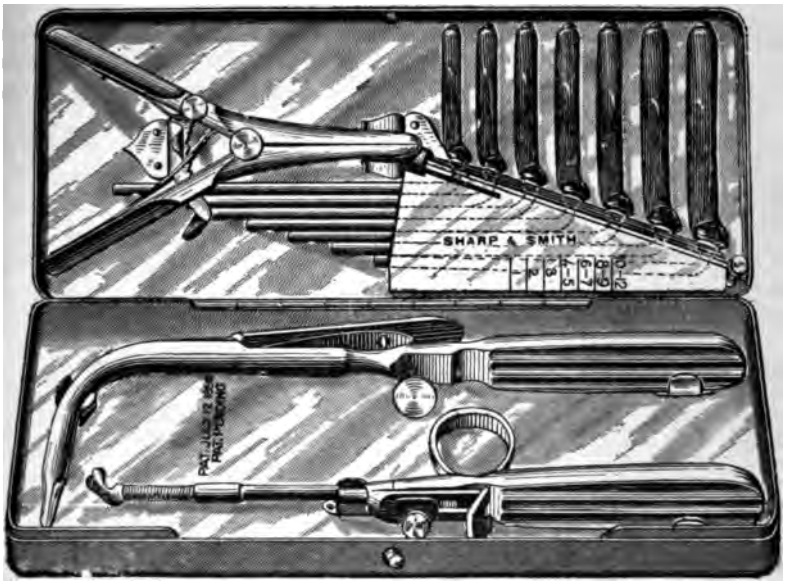

Fig. 303.

INTUBATION OF THE LARYNX.

Intubation is practised for the relief of obstruction within the larynx, as in stenosis from diphtheria, inflammation or œdema glottidis. The O'Dwyer tubes are those usually used. (Fig. 303.) The tubes are graded in size and length to suit the different ages of the patients. Each tube has an inner hinge tube which is screwed to the retractor. In introducing the tube the child is held upright in the lap of a nurse who controls the hands and body; a second person standing behind the nurse supports and fixes the head; the mouth is gagged open and the operator, seating himself in front of the patient, introduces the left fore finger into the throat, depresses the tongue, raises the epiglottis and defines the entrance to the larynx. With the introducer in his right hand the tube is carried along the fore finger of the left hand into the throat, turned to a perpendicular and guided into the larynx by the left index finger. The button of the introducer is then pushed

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CHAPTER XV.

ACCIDENTS AND SURGICAL AFFECTIONS OI THE CHEST.

AFFECTIONS OF THE RIBS AND STERNUM.

An acute pyogenic osteomyelitis may occur in the ribs or sternum as primary or secondary affection. It is however of rare occurrence. Th process may also follow typhoid fever. It runs an acute course and i followed by necrosis.

Syphilitic gummata may occur in the sternum and most frequently i the upper portion. The gummata break down, leaving the bone eroded.

The treatment of osteomyelitis of the ribs or sternum is early incision evacuating the pus and freely draining the cavity. The treatment of syphili tic gummata is the internal administration of iodide of potash, local curet tage of the ulcer and the maintenance of cleanliness and free drainage.

TUBERCULAR AFFECTIONS OF THE RIBS AND STERNUM.

Tubercular inflammation implicating the ribs is quite a common affec tion; it occurs less frequently in the sternum. The process either com mences as a tubercular periostitis or as a tubercular caries, and is seem ingly most frequently situated upon the internal surface of the rib. The ri or ribs are often found denuded of their periosteum for a considerable dis tance, and their surfaces eroded. There is often a chronic abscess beneat the skin, which connects by a narrow fistulous track running through an in tercostal space to a cavity beneath the ribs.

SYMPTOMS AND COURSE.—The patient is usually debilitated, anæmic weakly and ordinarily will have lost flesh. The disease comes on gradually there is localized tenderness and pain over the rib or ribs, followed by a cir cumscribed swelling. There is usually a slight evening rise of temperature The patient for a considerable time is able to keep at work. The swelling however, increases, and after weeks fluctuation is apparent.

TREATMENT.—It is of no avail in this class of cases where the perios teum or rib is involved, to simply incise the abscess and curette the cavit The process is beneath and within the rib. The abscess should be freely in cised and curetted, the fistulous track followed to the rib or through the in tercostal space and the carious rib or ribs freely removed. This is readil done by making an incision along the rib, separating the periosteum with periosteal elevator, being careful not to open the pleura, and then re moving the rib with bone forceps. If other ribs are affected they shoul also be removed. The abscess beneath the rib is then carefully curette wiped out and packed with iodoform gauze.

If the process lies in the sternum it is a much more serious condition and more difficult to treat. In the treatment the same principles, however, hold good. The chondro-costal cartilages connecting with the diseased area of the sternum should be divided, and the diseased portion of the sternum shelled out of its periosteal covering. The anterior mediastinum will be opened. The cavity is then carefully cleansed, curetted, if necessary, and packed with iodoform gauze.

Following the removal of either the ribs or sternum for tubercular disease, no effort should be made to close the wound by suture. What is desired is a free opening, thorough drainage and a destruction of the tubercular tissue. This is often readily attained if the above principles are carried out.

The results are as a rule most satisfactory.

WOUNDS.

These may be non-penetrating or penetrating. In non-penetrating wounds of the chest wall the same principles of treatment apply as in wounds situated elsewhere. Primarily hemorrhage is to be arrested. Then the wound should be thoroughly cleansed and free drainage established. One should not forget, however, that in contusions and wounds of the chest wall a traumatic pleurisy, pneumonia or pericarditis may follow. These traumatic secondary affections, unless due to septic emboli or septic processes, usually run a mild course.

Penetrating wounds of the chest wall are much more serious and may implicate the lungs, heart or important blood vessels. These wounds are especially serious in consequence of the liability to hemorrhage and sepsis. If air enters or is expelled from the wound, it is at once apparent that the pleura has been entered. If the patient expectorates blood, it is at once recognized that the lung has been injured. If the wound was made by a bullet, the direction from which it came, its size, and the presence or absence of a wound of exit, should be ascertained. These facts will enable one to judge to some extent of the seriousness of the injury and the structures injured. If the patient is severely shocked this condition should be treated by the administration of strychnine, morphine and caffein hypodermically. Possibly rectal enemata of coffee and milk may also be given,—while hot bottles are placed about the body. If the symptoms indicate internal hemorrhage, it may come from an intercostal, internal mammary, or from the lung or heart. In any event the wound should be sufficiently enlarged so that the bleeding vessel can be secured. If the hemorrhage comes from the lung the chest wall should be widely opened, the lung brought to the surface by the introduction, if necessary, of the hand, and the bleeding vessel or vessels secured with hæmostatic forceps. If the vessels cannot be tied the forceps may be left in place for 24 or 36 hours, while the pleural cavity is drained. If the vessels cannot be secured with forceps the wound in the lungs and pleural cavity should be tightly packed with sterilized gauze. This is left in position until the bleeding has been arrested. Aside from this the wound is thoroughly asepticized and drained, a large dressing applied and the chest snugly bandaged.

COMPLICATIONS.—Emphysema may occur and is an indication of per foration of the costal pleura. The condition is not likely to happen, how ever, unless the external wound is small. In emphysema air enters th subcutaneous tissue and produces a local or general bloating of the body The subcutaneous tissues crackle on palpation. The condition does not com on immediately and usually disappears in a few days, without treatment.

HERNIA OF THE LUNG.

In cases in which the chest wall is only slightly opened a hernia of som portion of the lung may occur. In such a case the opening of the chest wa may, if necessary, be enlarged and the protruding portion of the lun returned. If the portion of the lung which protrudes has been so presse upon as to destroy its vitality, it may be ligated and removed.

SEROFIBRINOUS PLEURISY.

It is claimed that the result of post mortem examinations has estab lished the fact that one-half of the cases of pleurisy are due to tubercular in fection. Pleurisy may also be primary, or secondary to a focus of inflam mation in the lung, and due to pneumococcic infection. Pleurisy may als be due to streptococcic infection, to a streptococcic pneumonia or to infec tion in some distant focus. Pleurisy very frequently follows a wetting o chilling of the body, and also may follow injuries of the chest wall.

In sero-fibrinous pleurisy the surface of the pleura is more or less cov ered with a fibrinous exudate. The serous exudate is usually free, and ma be clear, lemon-colored or very dark. The serous exudate is often turbi from the admixture of fibrinous material. If the exudate is large the lun is quite markedly compressed against the posterior part of the ribs an spine; and is dark in color, often bloodless and contains little or no air.

SYMPTOMS.—Pleurisy is usually ushered in with a chill, followed by fever which often reaches 102° or 103° F. There is also marked dyspne and an acute, intense stabbing pain in the side upon deep inspiration o when the patient coughs. A short, hacking cough is usually present, bu there is little expectoration. An examination of the chest during the firs day will disclose a dry friction sound over the inflamed area.

The affected side is less mobile than the other, and with the appear ance of a serous exudate the side is increased in circumference from one half to two inches. The heart, where the serous exudate is considerabl may be pushed to the right or left, depending on the situation of the effu sion. The normal resonance gives way to a dull or flat percussion note, i cases of pleurisy with effusion. The extent of the dullness will depend up on the amount of fluid. With the increase of fluid, the dullness increase and extends from below upwards. Perhaps the most important sympto is the absence of the tactile fremitus or voice vibrations which are so dis tinctly felt in the normal condition by placing the palm of the hand agains the posterior wall of the chest, and having the patient count in a distinc voice. In cases of pleurisy with effusion this tactile fremitus is diminishe or entirely disappears.

Before the serous exudate has occurred, dry friction sounds are to b heard on auscultation. With the advent of the serous exudate the serou surfaces are separated and the friction sounds disappear. With the accu

mulation of fluid the normal respiratory murmur becomes less distinct, more distant and finally disappears. Bronchial respiration may be heard at times over the seat of the fluid, or there may be practically an absence of all respiratory sounds.

DIAGNOSIS.—The diagnosis will depend upon the history of the case, the physical examination of the chest, and, if necessary, upon the introduction of a hypodermic needle.

PROGNOSIS.—Sero-fibrinous pleurisy usually runs a favorable course, the fluid being spontaneously absorbed.

TREATMENT.—If the fluid does not disappear under medicinal treatment in a reasonable time, or is making injurious pressure upon adjacent organs, it should be withdrawn.

The Withdrawal of Fluid from a Pleural Cavity—Paracentesis Thoracis.—This should be done under strict aseptic precautions. It is carried out by introducing a small trocar in the fifth or sixth intercostal space, and on a line with the posterior border of the axilla. During the withdrawal of the fluid the patient may sit upright in a chair, or may lie down at the edge of the bed. To lessen the pain caused by the introduction of the trocar the skin may be frozen or rendered anæsthetic by the injection of cocain, and then a small nick should be made in the skin with a knife. As a stimulant the patient may be given morphine and strychnine before the introduction of the trocar. After the withdrawal of the serous exudate the patient should have his bowels kept thoroughly open, and given as little fluid by the mouth as is possible. If the fluid reaccumulates it may be again withdrawn. Very frequently the administration of salicylate of soda in 10 to 15 grain doses, four to five times a day will produce very free diaphoresis and favor the absorption of the fluid within the pleural cavity.

EMPYEMA.

By this is understood a collection of pus within the pleural cavity. It may result from a traumatism, with infection, from various lung affections, from a preceding sero-fibrinous pleurisy with infection, or it may occur as a primary condition. In children more than one-half of the cases are due to the pneumococcus, either alone or in conjunction with the streptococcus. In adults the majority of cases are due to streptococcus infection. They may, however, be the result of tubercular infection or to any one of the pyogenic germs.

PATHOLOGY.—Pus is present in the pleural sac and is constantly added to until it fills the cavity to its utmost limit. The pleura is reddened, hyperæmic and thickened, while upon its surface there is more or less of a plastic exudate. In long-standing cases the pleura becomes at times enormously thickened; it may be half an inch in thickness or even more. This is especially true in long-standing tubercular affections. As the pus accumulates the lung becomes pressed down in the groove at the side of the spinal column. Its alveolar structure is retained if the pus is withdrawn, and after a few days, the lung re-expands, filling its accustomed space, and obliterating the pleural cavity. If, however, the pus is allowed to accumulate for ten days or more and comes to fill the pleural cavity, then and in that case the alveolar structure of the lung disappears, and inflammatory exudate in-

filtrates its structure, the visceral pleura becomes thickened and forms fi adhesions to the adjacent structures, with the result that when the pus withdrawn the lung cannot expand, or can only partially expand, and fill side of the chest. Consequently the pleural cavity remains as a large o sac and continues to discharge pus. There is, however, an effort made the surrounding organs and structures to obliterate this space, and in so cases success attends these efforts. Especially is this true if the collap lung is able partially to expand. In these cases the opposite lung underg enlargement and hypertrophies, and with the heart extends into the oppo side of the chest cavity; the abdominal organs and diaphragm are displa upwards, and the chest wall upon the diseased side falls in; the spine comes curved with its convexity in the opposite direction; and a consid able growth of granulation tissue covers the pleural surfaces. If the ca is not large it will be obliterated by these means.

DIAGNOSIS.—This is reached by considering the history and sympto making a physical examination of the chest, and, if thought necessa withdrawing some of the fluid through a hypodermic needle.

PROGNOSIS.—This will depend in a large measure upon the organis causing the infection. If caused by the pneumococcus the prognosis is g erally good; if caused by the streptococcus the prognosis is serious; whil the infection is due to the bacillus of tuberculosis the prognosis is grave.

TREATMENT.—This consists in withdrawing the pus at the earliest p sible moment. Under ordinary conditions the pus is not only withdra but free drainage established. When the process is due to pneumoco infection and the patient is a child aspiration is occasionally success Aspiration is also occasionally practised when the amount of fluid is treme, in order to afford less hindrance to the sound lung during the ministration of an anæsthetic.

In the operation for empyema, as ordinarily performed, an incision inch and a half or two inches long is made over the seventh or eighth and just behind the posterior axillary line. The periosteum is divided and s arated from the rib by a periosteal elevator. An inch or an inch and a h of the rib is then resected, and the pleural cavity opened through a v short incision. This is for the purpose of preventing the pus from be evacuated too rapidly. When a considerable portion of the pus has b drained away, the incision should be enlarged and the finger introduced the purpose of removing any masses of fibrin which may be present. T short drainage tubes are then introduced within the wound and fastened a large safety pin, which is incorporated within the dressing, so that t cannot slip entirely within the pleural cavity. The dressings for the f few days should be changed at least two or three times during each hours, as they become readily saturated with the large amount of dischar If the pus is virulent and has undergone decomposition the cavity sho be washed out with each dressing. Otherwise irrigation of the cavit not necessary.

Estlander's Operation.—In cases in which the operation for empye is deferred until the alveolar structure of the lung has become obliterat the lung bound down by plastic exudate and incapable of expanding a the withdrawal of the fluid, it becomes necessary to collapse the chest v

onto the lung. This is done by resecting a portion of a half dozen or more ribs (Fig. 304).

The operation is ordinarily carried out as follows: A longitudinal incision is made from the axilla downwards to about the eighth or ninth rib. This incision goes down to the ribs. The soft tissues are widely retracted, the periosteum divided over a rib at the center of the incision, and four or five inches of this rib removed. About three inches of the rib above and below this is then resected; then perhaps two and one-half inches of the rib above and below these, and perhaps one inch of the rib still above and below those last removed, are resected. In this way a great space is made in the stays

Fig. 304.—Showing collapse of chest wall after Estlander's operation.

of the chest wall, these come together, the chest falls in, approximates itself to the partially collapsed lung, and the pleural cavity becomes obliterated and the discharge ceases. In severe cases where the pleural sac is large it cannot be collapsed in any other way.

The patient in this class of cases pays a frightful price for the neglect of the physician, in that he loses practically the use of one lung, which subsequently is liable to become diseased. The chest wall is very much deformed and he suffers lateral curvature of the spine.

Schede's Operation.—In cases in which the pleura has become enormously thickened, and especially where the process has long been chronic and perhaps tubercular, the resection of the ribs is not sufficient to collapse

the chest wall or obliterate the cavity of a very thick walled sinus. In these cases Schede recommends (and his line of treatment has been quite generally and successfully followed) not only resection of a portion of a number of ribs, but resection of the entire chest wall overlying the cavity or fistula. This can readily be done with a pair of not very sharp bone forceps, after the skin and soft tissues have been divided and retracted.

GANGRENE OF THE LUNG.

This is not a disease of itself, but a complication which may occur in a variety of diseases or pathological conditions. First it has most frequently occurred in cases of lobar pneumonia in persons who are much debilitated, and especially in those suffering from diabetes. Second, it may follow aspiration pneumonia. Third, it occasionally occurs as the result of local infection and putrefaction of tissue around bronchiectatic or tubercular cavities. Fourth, gangrene may follow embolism of the pulmonary artery.

PATHOLOGY.—Gangrene of the lung occurs as a diffuse and as a circumscribed process. The former may follow pneumonia or a blocking of a large vessel. In this form an entire lobe may be invaded and converted into a soft, spreading, disintegrating and horribly offensive mass. Diffuse gangrene of the lung is a rare condition.

Circumscribed gangrene is much more frequent. In this form there may be a single gangrenous area or the foci may be multiple. They are usually small and well circumscribed. The peripheral portion of the lower lobe is most frequently implicated. In circumscribed gangrene of the lung, a cavity is formed, and filled with a horribly offensive fluid and broken down lung tissue. The walls of the cavity are ragged and the tissues in a gangrenous condition. The immediately surrounding lung tissue is inflamed and often consolidated, while the lung tissue lying without this area is markedly œdematous.

SYMPTOMS AND COURSE.—This process usually comes on during the course of a pneumonia. At the end of a week or ten days instead of the pneumonic process undergoing resolution, the fever continues and the consolidation remains without assignable cause. The patient now has severe paroxysms of coughing and the breath becomes offensive, especially during these paroxysms. Following this the material expectorated is bloody and has the penetrating and characteristic odor of gangrene. If the patient expectorates into a conical glass the material separates into three layers. The uppermost is a thick, frothy material; the middle layer is represented by a thin, greenish liquid; while the lower layer consists of a greenish or brownish, heavy sediment. In the material expectorated lung tissue and elastic fibres are to be found. Hemorrhage from the gangrenous area is frequent, often severe and occasionally fatal. It is due to the sloughing process opening blood vessels of considerable size. Unless the gangrenous area opens into a bronchus, it may run its course and even end fatally without being suspected.

The pathognomonic symptoms of gangrene are the horribly fetid and penetrating breath, and the appearance of elastic fibres in the sputum.

PROGNOSIS.—The prognosis of gangrene of the lung is very grave. Probably all cases of diffused gangrene end fatally, while very many of those

in which the process is circumscribed terminate fatally in consequence of septic absorption or hemorrhage.

TREATMENT.—The patient should be supported by proper liquid food and tonics. If the process has broken into a large bronchus and has good drainage, and severe hemorrhages do not occur, the patient may recover without surgical interference. If the cavity is not well drained, or there are severe hemorrhages, the cavity should be drained externally if it can be located. The signs of a cavity may be present, and if so will indicate its position. The location of the cavity may be determined by the introduction of a long hypodermic needle. If one is not successful at the first insertion the needle is withdrawn and entered in a different direction. As a rule the cavity should be located before one proceeds with the operation, and if it cannot be located the operation should not be undertaken. If the cavity is once located a perpendicular incision is made three or four inches in length and portions of one, two or three ribs resected. The incision is then made through the parietal pleura, and if the two pleural surfaces are adherent the incision is carried directly into the lung and gangrenous area. If the two pleural surfaces are not adherent they may be stitched together about the supposed gangrenous area or packed about with iodoform gauze. The remainder of the operation may be deferred for a day or two, or the gangrenous area may be at once incised.

After opening the gangrenous region it should be wiped out with absorbent gauze and then packed with reasonable firmness with long strips of iodoform gauze. These strips of gauze will have a favorable effect upon the gangrenous tissue, will afford drainage and prevent severe hemorrhage.

ABSCESS OF THE LUNG.

(1) Abscess of the lung may occur as a consequence of pneumonia. (2) It may be the result of aspiration or deglutition pneumonia. (3) It may be the result of septic processes following operations upon the neck or throat, or follow suppurative processes in the naso-pharynx. (4) It may follow cancer of the œsophagus, which has reached the lung and produced suppuration. (5) Abscess of the lung may result from infected emboli reaching the lung in cases of pyæmia. (6) Abscess of the lung may result from penetrating wounds of the chest. (7) Abscess of the lung may occur in tubercular processes.

SYMPTOMS AND DIAGNOSIS.—An abscess following a pneumonia may be recognized by an aggravation of the symptoms, and by the physical signs of a cavity, coupled with the expectoration of quantities of fetid pus. This fetor is much less than it is either in gangrene or fetid bronchitis. Small abscesses, especially those due to embolism, cannot ordinarily be located, and often are not recognized.

[illegible]—If the abscess is being well drained through a large [illegible] surgical interference is unnecessary. If the abscess is not well [illegible] and it can be located by the physical signs and the use of a long [illegible] needle it should be cut down upon and drained externally. The [illegible] of opening the abscess, before proceeding with the operation, is [illegible] the chest wall has been incised the lung collapses in conse- [illegible] atmospheric pressure, the relations of the parts are altered,

and it is most difficult if not impossible then to locate the seat of the pathological process.

PERICARDITIS WITH EFFUSION.

This process is most frequently secondary to rheumatism. It may be secondary to tonsillitis, septic processes, tubercular processes, the eruptive fevers and traumatisms.

SYMPTOMS.—There is precordial pain, with marked tenderness, fever and perhaps a chill, dyspnœa, small, rapid and at times irregular pulse.

If the effusion is marked the precordial space bulges, the apex beat disappears, the precordial dullness increases markedly and becomes pear-shaped or like a triangle with the base below; on auscultation the friction sounds of the first stage have disappeared, and the heart sounds are indistinct, muffled and seem distant.

TREATMENT.—Rest should be secured and in the first stages an icebag applied; this often markedly reduces the amount of the effusion. When the effusion is large a blister may be placed over the precordial space. In those cases in which there is serious disturbance of the heart's action as shown by dyspnœa, quick pulse and a dusky, anxious countenance, paracentesis pericardii should be resorted to.

PARACENTESIS PERICARDII.

The trocar is introduced in the fifth interspace two inches to the left of the left border of the sternum. The fluid should be slowly evacuated, and in case it is found to be purulent a free incision should be made in the fifth intercostal space, remembering the position of the internal mammary artery, which is situated about one-half an inch distant from the border of the sternum.

DEFECTS OF THE NIPPLE AND MAMMARY GLAND.

CONGENITAL MALFORMATIONS.

At times one or more accessory glands or nipples are present. These may be situated above or below the normal gland, or they may be located in the axilla or on some other portion of the body. Occasionally the mammary glands are wanting. Diffuse hypertrophy occasionally occurs and in this condition any of the histological structures of the gland may be so increased as to produce an enormous enlargement. In some cases the glands become so large that they drag the patient forward by their weight and reach down to the thighs.

TREATMENT.—Glands that are markedly hypertrophied and causing discomfort should be removed.

FISSURES OF THE NIPPLES.

Fissures of the nipples frequently occur during lactation. The condition may be represented by an abrasion of the epithelium or by a deep crack or ulcer. They may be situated upon the top or sides of the nipple. The condition causes very severe pain and often bleeding when the child takes the breast. Abrasions and fissures are usually caused by the tender nipple being traumatized and its epithelium macerated during the frequent

acts of suckling. The superficial epithelium is macerated and rubbed off, infection occurs, followed by more or less ulceration.

TREATMENT.—This should be in a measure prophylactic, and directed towards hardening the nipples during the last months of pregnancy. The breasts should not be too warmly covered, and the epithelium of the nipples hardened by the application of dilute alcohol. After the confinement the nipples should be bathed after each act of nursing with some mild antiseptic, such as a saturated solution of boric acid. The nipples should then be well dried with a soft cloth, and lightly powdered with zinc oxid. Tincture of myrrh is also a popular remedy used for the purpose of hardening the nipples. If abrasions occur and do not readily heal by strict cleanliness, the application perhaps of compresses wrung out of a warm saturated solution of boric acid may be of advantage, or they may be lightly brushed with a 10 per cent. solution of nitrate of silver. If the child can be induced to use a nipple shield, this will lessen very materially the pain of suckling, and will also, by keeping the nipple dry, assist markedly in the healing process.

ECZEMA OF THE NIPPLE.

This is an infrequent condition, and presents the characteristics of eczema on other skin surfaces, and requires the same treatment.

PAGET'S DISEASE OF THE NIPPLE.
DERMATITIS MALIGNA.

This is often mistaken for ordinary eczema. The surface of the nipple is red, denuded, and often the site of a free, yellowish discharge. Following this scabs and crusts form and the disease spreads peripherally. It has a well-defined margin which is thickened and indurated, and the process is followed by ulceration, and finally retraction of the nipple. The condition cannot be made to heal by any of the ordinary methods of treatment, and leads to a characteristic epithelioma in which the skin, and not infrequently the ducts, are affected.

TREATMENT.—The area should either be exposed to the X-ray treatment or freely excised.

ABSCESS OF THE AREOLA.

This is not infrequent in young girls. The infection occurs through the sebaceous follicles. The abscess should be freely opened and drained.

INFLAMMATORY AFFECTIONS OF THE BREAST.

ACUTE MASTITIS.

Acute inflammation of the mammary gland is of frequent occurrence in puerperal women. It is due to the pronounced functional activity of the gland during lactation, plus infection. Circumscribed mastitis frequently occurs from the temporary blocking of one or more of the ducts, or it may result from an injury. In these cases a hard, tender, quite well circumscribed lump occurs in some quadrant of the gland.

Under gentle massage and warm applications the induration usually disappears in a few days.

SUPPURATIVE MASTITIS.

In this process the infection reaches the gland either through an abrasion or fissure of the nipple, or through the general circulation in cases of puerperal septicæmia. If the infection occurs through the nipple it may be through the lymphatics or milk ducts. In the former case the pus formation will occur in the connective tissue between the lobules. In the latter it is primarily between the acini of the gland. In suppurative mastitis secondary to septicæmia there are often multiple and distinct abscesses which occur in succession. The pus may be situated subcutaneously—supra-mammary abscess; within the lobules—intra-mammary abscess; or beneath the gland—sub-mammary abscess. Frequently the pus is widely diffused through the gland.

SYMPTOMS.—The process frequently comes on with a chill and high fever, followed by a very sensitive and painful node within the breast. The primary induration rapidly increases in size; secondary indurations may occur, and the breast become markedly swollen. In two or three days the overlying tissues become œdematous and the skin red. The part feels boggy, and after a short time indistinct fluctuation may be detected. The infant often refuses to take the breast, in consequence of which it becomes greatly engorged and the secretion diminished. If the child suckles the act causes excruciating pain.

TREATMENT.—In acute mastitis the breast should be gently massaged several times each day with hot camphorated oil, and then enveloped in absorbent cotton and snugly compressed with a bandage. The patient should be kept quiet in bed, on a light diet, and have the bowels thoroughly opened. If the inflammation and fever are progressive and pus formation has probably occurred, a free incision should be made so as to establish perfect drainage. In neglected cases where there are many pus pockets the patient should be given an anæsthetic and every pus pocket freely opened. These incisions should always pass through the indurated areas and radiate from the nipple towards or to the outer border of the gland. They should correspond in direction to the lines of the ducts and lobules. Not infrequently an incision must go entirely through the gland in order to reach a sub-mammary abscess. The principles which should guide one in making the incisions are, to thoroughly open every infected area and to establish perfect drainage. In severe cases many drainage tubes will have to be inserted. The dressing should be frequently changed and the pus cavities thoroughly irrigated with each change of the dressings. It is often advisable in these cases to administer quinin and strychnin. The patient should be well nourished with liquid food.

CHRONIC MASTITIS.

Chronic mastitis occurs in two forms. In one the process is confined to one or more lobes of the breast. This process may be the result of imperfect involution following lactation, the result of an acute attack, or an injury. The affected lobe is somewhat swollen, hard, and painful, and often the site of neuralgic pain.

In the treatment an ichthyol, belladonna, vaseline ointment may be applied, followed by a compress and a firm bandage.

CHRONIC INTERSTITIAL MASTITIS.

This is a frequent condition which usually occurs shortly before, or at the time of, the climacteric. It is primarily an involution process, in which there is an overgrowth of the connective tissue of the gland. This new tissue contracts, producing hard, somewhat nodular indurations, confined, perhaps, to some one quadrant, or implicating the entire breast. At the same time there often is a proliferation of the epithelial cells of the acini and ducts. These structures become more or less filled with these cells, which undergo degeneration, and form a thick, grumous-like mass. The acini and ducts are still further dilated by a serous exudate. In consequence of the contraction of the new tissue the contents of the acini and ducts is retained and small, round, elastic cysts are formed. The process is usually diffuse, and generally implicates both breasts.

SYMPTOMS AND COURSE.—It usually occurs between the thirtieth and fortieth years of age. It comes on gradually, is attended with but little pain, while the breast is only slightly enlarged and somewhat tender. The condition may go on to general atrophy or to the formation of innumerable cysts.

DIAGNOSIS.—Chronic mastitis is to be differentiated from tubercular processes of the breast, and from cancer. Tubercular processes usually occur in young, poorly nourished women who are predisposed to or have a family history of tuberculosis. The infection is usually manifested by the occurrence of multiple nodes which are hard, irregular and non-elastic. At a later stage tubercular abscesses may occur. The axillary glands are usually enlarged.

In cancer the axillary glands are always enlarged. The induration is usually single and confined to one breast. The patient has ordinarily passed the fiftieth year. There are no cysts within the breast.

The characteristics of chronic mastitis are that it occurs most frequently between the thirtieth and fortieth years of age; that it is diffused, and often implicates both breasts; that there are many hard, indurated areas and many cysts; that the process is chronic, and that the general health is not interfered with nor the axillary glands ordinarily enlarged.

TREATMENT.—In the treatment of chronic mastitis mild counter-irritation should be practised, with compression and support. If cysts of considerable size occur, they may be incised and drained, or, if they are quite closely packed together, a quadrant of the breast may be excised.

TUBERCULOSIS OF THE MAMMARY GLAND.

Tuberculosis of the mammary gland is most frequently found in young women between the ages of twenty and thirty-five, or during that period when the gland is functionally most active. A few cases have been reported as occuring before and after menstrual life. The process is most frequently observed in spare, weakly, anæmic individuals, and in those who have inherited the so-called scrofulous diathesis, or tubercular predisposition, and especially in such as have a parent or near relative who has or is suffering from tuberculosis.

Tubercular infection of the mammary gland may be primary or secondary. When primary it may occur through the milk ducts or through

abrasions of the nipple. It is thought that the great majority of cases are secondary to a tubercular process in the lymphatic glands of the axilla or neck, or to one in adjacent ribs, pleura or lung. The focus, however, may be situated in distant bones, in the genito-urinary or intestinal tract, in the peritoneum, or skin. When secondary and the foci are situated more or less remotely, infection may occur through the arterial circulation. Infection in many of these cases, however, occurs through the lymphatic circulation by a retrograde process. Infection carried against the lymph-current is seen every day in cases of carcinoma. The bacilli of tuberculosis are often carried against the normal lymph current by cellular action, or by reverse currents.

Infection may also occur by contiguity of structure in cases where the sub-mammary tissues, the adjacent ribs or parietal pleura are implicated. If infection occurs through the milk ducts the process must be situated primarily between the ducts or the acini. If the bacilli reach the breast through the circulation, lymphatic or arterial, they would naturally be arrested in the tissues directly surrounding the alveoli, as here the arteries break up into a network of capillaries, while the lymphatic radicals take origin within and about the lobules of the gland.

Symptoms and Course.—The clinical picture presented by a tubercular process within the breast is somewhat variable. It will depend largely on the stage of the disease during which the examination is made and the number of foci primarily infected, and also on the fact as to whether the process is primary or secondary. In many of these cases, as can be readily appreciated, the primary disease will be of such importance or severity that the condition of the breast, even if severe, will be of little or no moment. The patient's attention may first be called to the process by pain, which is usually early experienced, is pretty continuous, and has a dull, heavy, aching or burning character. Not infrequently, however, the pain is scarcely noticeable, and the patient's attention is first directed to the breast in consequence of finding therein a node or nodes. These nodes, and there are usually more than one, are reasonably hard, somewhat sensitive, and quite irregular. They cannot be distinctly separated from the gland structure, and ordinarily vary in size from that of a hazelnut to half an inch or inch and a half in diameter. They are seldom round, but are flat or have a very irregular contour. These nodes are often distinctly separated, but still lie in the same quadrant of the breast. The fact of there being multiple nodes is in a measure characteristic of the disease. The gland as a rule is not enlarged and on simple inspection nothing is to be seen. The axillary glands during this early stage may be enlarged.

As the condition progresses the nodes increase in size, however very slowly, possibly coalesce, become elastic, and finally impart a sense of fluctuation. They may become adherent to the skin and the contents of the abscess be discharged from a fistulous tract. If the process is allowed to go on without treatment several fistulæ are likely to be formed in consequence of the breaking down of many nodes. While ordinarily the gland is not enlarged during the first stage of the disease, later, if pus in any considerable amount is formed, the breast becomes noticeably increased in size.

Diagnosis.—This will depend upon the antecedents, the appearance of

the patient, the history of the case, and the physical examination. The antecedents will often show scrofula or tuberculosis. The patient's appearance is often that of a thin, anæmic, weakly woman of lessened resistance, while the history may establish the probability of tubercular process in other parts of the body. The examination will usually disclose, if made before the formation of an abscess, one or more quite hard, very irregular, well-defined, not specially sensitive nodes, which are inseparable from the glandular structure. The axillary glands are enlarged and the nipple at times retracted. When pus has formed the use of the hypodermic needle and the microscope will materially aid in establishing the diagnosis.

When fistulæ are present, the process being chronic, the diagnosis is easy.

The process should be differentiated from scirrhus, and from chronic mastitis. In scirrhus the patient is usually more than fifty years of age. The node is single, and harder than in tuberculosis. In chronic mastitis there are many nodes and many cysts. The axillary glands are not enlarged under ordinary conditions and the health of the patient is not interfered with.

TREATMENT.—This consists in free excision of the infected area. If the entire gland seems implicated it should be removed, while the axillary glands, if enlarged, are also to be enucleated.

CYSTS OF THE MAMMARY GLAND.

First, acinous or retention cysts. These arise from obstruction of a duct or ducts or from obstruction of an acinous of the gland. In consequence of this obstruction the secretion is retained and a cyst produced. They are most frequent in puerperal women—galactocele cysts.

Second, involution cysts are frequent, as already described, at or about the time of the climacteric, especially in unmarried or sterile women. In these cases dozens of cysts may occur in each breast, producing a hard, nodular, indurated condition.

Third, cysts are said to occur as the result of frequent irritation of the nipple. In consequence of this irritation a secretion is established within the breast which is in part retained, producing a cyst.

Fourth, cysts may occur from dilatation of the lymph spaces. These may be unilocular or multilocular. They are lined by endothelial cells.

DIAGNOSIS.—Cysts of the mammary gland are round, smooth, elastic, often very hard, and at times fluctuant. The diagnosis is often difficult without the use of the hypodermic needle.

TREATMENT.—If the cyst is annoying the patient in any way it may be excised, or incised and drained, or the fluid may be withdrawn and a drachm of tincture of iodine injected, followed by firm support.

SOLID FIBROID TUMOR OF THE BREAST.

This neoplasm usually occurs in young girls as a round, reasonably smooth, elastic, freely movable, slowly growing, and encapsulated tumor. It seldom is larger than an English walnut, is free from pain and tenderness, and is most frequently situated at the periphery of the gland. Microscopically the tumor is made up of connective tissue cells and fibrous tissue.

CYSTIC FIBROMA.

DIAGNOSIS.—The diagnosis is made by considering the age of the tient, the fact that the growth is single, freely movable, elastic, increases very slowly in size, and almost never attains large dimensions. To dif entiate a fibroid from a cyst the use of the hypodermic needle may be ne sary.

TREATMENT.—The treatment is excision. Two curvilinear incisions made surrounding the growth and removing no more of the breast tha necessary, or the growth may simply be cut down upon and enucleated.

This tumor occurs as a rule in young women. It is made up of fibı tissue enclosing clefts and spaces. These represent the remnants of d and acini. These acini and remnants of ducts have been included in growth of fibrous tissue, compressed, and their secretion retained.

The tumor is usually single, somewhat nodular, elastic, freely mova and of a somewhat more rapid growth than the solid fibroid. Its cystic cl acter may only be determined by the use of the hypodermic needle.

TREATMENT.—This consists in the removal of the growth.

VARIOUS MAMMARY GROWTHS.

Angioma, osteoma, lipoma and chondroma also occur in the bre They are, however, very rare tumors in this situation, and possess no spe features. When occurring they should be freely excised.

THE ADENOMATA.

These occur as solid or cystic growths. The solid growths have b divided into the hard adeno-fibroma, and the soft adeno-fibroma. The of an adenomatous growth is that there is a new formation of glandular sue within the tumor. The hard adeno-fibroma resembles in its gen characteristics a hard fibroid. The soft adeno-fibroma grows rapidly quite soft, and at times reaches a very considerable size. The growt usually single. The hard and soft adeno-fibroma cannot, except mi scopically, be differentiated from the hard and soft fibroid growths.

The adeno-cystoma occurs in young women. The acini and ducts resent a new growth and come from the cells of pre-existing acini, as result of a free proliferation. The ducts and acini are filled with villou fibro-papillomatous growths. The distention of the acini and ducts is aided by a free serous or bloody exudate. This exudate often makes escape from the nipple. These growths may reach a very considerable s They grow quite rapidly, and are soft, nodular, elastic, freely movable mors, which at times fluctuate, but present none of the characteristics malignancy. When reaching considerable size they may form pressure inflammatory attachments to the skin, and the axillary glands may be creased in size as the result of irritation.

In the treatment of these growths they should be freely removed.

SARCOMA OF THE MAMMARY GLAND.

This is a malignant, but comparatively a rare, growth in this gl The cystic sarcoma seems to be most frequent in this situation, and ha origin from the periacinous tissue. The growth occurs as a large, bos

[illegible] rapidly growing tumor which is most frequently encountered in young women. Its surface often has an unequal consistence in consequence of the formation of mucous or hemorrhagic cavities. These cavities or [illegible] may be due to degenerative processes or to partially obliterated acini or ducts, into which hemorrhage has occurred, or papillary masses covered with epithelium in a condition of atrophy have grown. In the [illegible] the normal stroma of the gland is replaced largely by round, spindle or giant cells. [illegible] sarcomatous growths also occur in the breast and are made up of round, spindle or giant cells.

[illegible]

[illegible] can ordinarily be [illegible] much more rapidly, [illegible] contrary invade or grow [illegible] large they seem to en- [illegible] growths are usually [illegible]

[illegible] the free removal of the entire breast, [illegible]

ENDOTHELIOMA OF THE BREAST.

The endotheliomata of the breast are apparently of more frequent occurrence than are the sarcomata. They occur in young women as reasonably soft, rapidly growing, tumors, which are without a capsule, and which infiltrate or encompass the gland. An endothelioma of the mammary gland often in three or four months reaches the size of an adult head. (Fig. 305.)

Microscopically the tumor is usually made up of strands of endothelial cells occurring in the lymphatic spaces or vessels. Between these strands of cells the connective tissue is frequently seen in a condition of mucoid degeneration.

DIAGNOSIS.—The endotheliomata cannot be differentiated from the sarcomata except by a microscopic examination. They occur in young women grow rapidly, reach considerable size in a few months, are of pretty uniform consistency, and envelop the gland. The axillary glands are usually not enlarged. At a later stage metastasis may occur in the adjacent subcutaneous

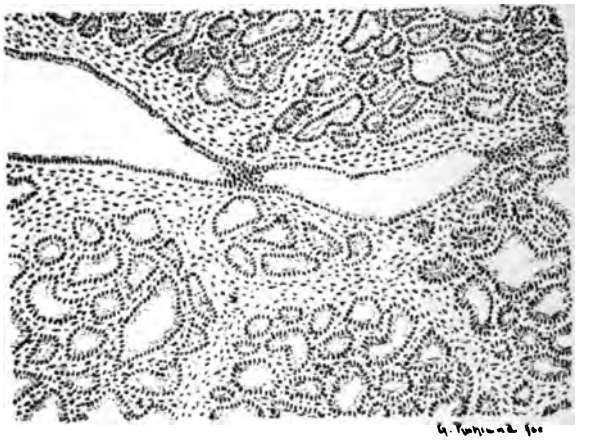

Fig. 306.—Normal glandular tissue of mammary gland.

tissue and in the bones and internal organs. An endothelioma occurring in the breast should be removed by free excision at the earliest possible moment.

CANCER OF THE MAMMARY GLAND.

This organ is affected with cancer more frequently than any other in the body, excepting the uterus. Cancer of the breast occurs in one of two forms, the scirrhus and the medullary carcinoma. These only differ in the amount of fibrous tissue and cells which they contain. They both take origin from the epithelial lining of the acini or ducts. (Fig. 306.) In the scirrhus the epithelial cells proliferate only to a comparatively slight degree. They come, however, more or less to fill the acini and ducts, and are surrounded by a proliferating mass of connective tissue which eventually form a node. This node is not encapsulated and extends into the glandular structure. The process occurs as a rule in women who are past fifty years of age. The lymphatic glands in the axilla are quite early involved and

show enlargement. They are not, however, always easily detected. The skin is only implicated late in the process. In consequence of the contraction of the fibrous tissue and the dragging on the ducts, the nipple becomes retracted and sometimes inverted. After a time, if the process is allowed to go on unchecked, the breast withers and becomes atrophied, the node becomes attached to the pectoral fascia and the chest wall, and also to the skin, which it infiltrates. The skin becomes reddened, finally eroded, and ulcerates, the ulcer is cup-shaped, and has upon its surface but few granulations, or is covered with necrotic tissue. The ulcer has a hard, indurated base and border, gives rise to a free watery discharge, and constantly extends, though but slowly. Hemorrhage is not a feature of the scirrhus

Fig. 307.—Scirrhus of Mammary Gland. Photograph shows Ulceration of Skin and Retraction of the Nipple.

ulcer. The odor given off from these ulcers, in consequence of the decomposition going on in the necrotic tissue is offensive. Occasionally the skin covering the gland, and that surrounding the breast, becomes infiltrated, hard and board like—cancer *en cuirass*. Again, subcutaneous nodes are formed near to or distant from the mammary gland. The glands in the anterior mediastinum and above the clavicle are frequently involved. Metastases also occur in the internal organs. In carcinoma of the
metastases most frequently occur in the bones, and this
noted by heavy, continuous or intermittent boring, g

which is experienced first in one bone and then in another, the patie finally succumbing as the result of the severe pain, inability to sleep, in bility to take nourishment, and from systemic poisoning. (Fig. 307.)

MEDULLARY CANCER.

This differs from the scirrhus in consequence of its being made u very largely of epithelial tissue. This tissue predominates, the fibrous ti sue being scant. The tumor is soft and grows very rapidly, producing in few months a globular mass perhaps the size of a fetal head, which con pletely envelopes the breast. The axillary glands early become implicate as well as the skin, pectoral fascia and chest wall. The patient early show symptoms of systemic poisoning; the skin is likely to ulcerate, and the ulc is of the fungus variety, being reasonably soft, having large granulatio on its surface, or quantities of necrotic tissue, is the site of a profuse water most offensive discharge, and often bleeds freely.

DUCT CANCER.

Carcinoma, taking origin from the epithelial lining of the ducts, ma occur in the form of malignant papillomatous growths. The condition o curs most frequently near the nipple. The ducts are lined by column epithelium, and the tumor has been spoken of as a columnar cancer. The are very vascular, bleed readily, and there is frequently a bloody discharg from the nipple. The tumor is of slow growth. The nipple is not always r tracted nor the lymphatic glands enlarged. The process occurs as a har not well-defined, irregular, non-encapsulated node situated near the nippl

Diagnosis of Scirrhus of the Breast.—Scirrhus of the breast, wi very few exceptions, occurs in women past fifty years of age, as a hard, i regular, not well-defined, non-encapsulated tumor of slow growth, which i filtrates rather than pushes to one side the adjacent tissue. The node single. The axillary glands become enlarged, and the process gradual extends; in the course of six months or a year it will ordinarily have becom fixed to the chest wall and to the overlying skin. The patient suffers as rule considerable pain through the breast, and after a few months begins lose flesh and, in some degree, strength, and becomes somewhat cachecti

The process is readily differentiated from tubercular nodes and cyst which are usually multiple and which occur as a rule in young adult life in young womanhood. The process may also be differentiated from cys and chronic abscesses by the use of a hypodermic needle.

Diagnosis of Medullary Carcinoma.—This is readily differentiat from all benign tumors of the breast in consequence of its very rap growth, and also from the further facts that it infiltrates and encompass the gland and produces metastases in distant glands and in distant organ Medullary carcinoma, however, cannot be differentiated, without a micr scopical examination, from a rapidly growing, round-celled sarcoma endothelioma, unless a probable differentiation may be made by the know that connective tissue malignant tumors usually occur in young pe reas epithelial malignant tumors usually occur only after fif

PROGNOSIS.—Scirrhus ordinarily terminates fatally, if left undisturbed, in from one year and a half to five years, although some patients have survived for fifteen or twenty years.

The medullary carcinoma may terminate fatally in three or four months, and usually destroys life inside of one year.

TREATMENT.—The treatment of malignant disease of the breast, whether sarcoma, endothelioma or carcinoma, should be along radical lines. In other words, there should be a very free excision, which includes the entire mammary gland and overlying skin, with a complete clearing out of all fatty tissue and enlarged glands in the corresponding axillary space. The gland is perhaps best removed by carrying a curvilinear incision from the

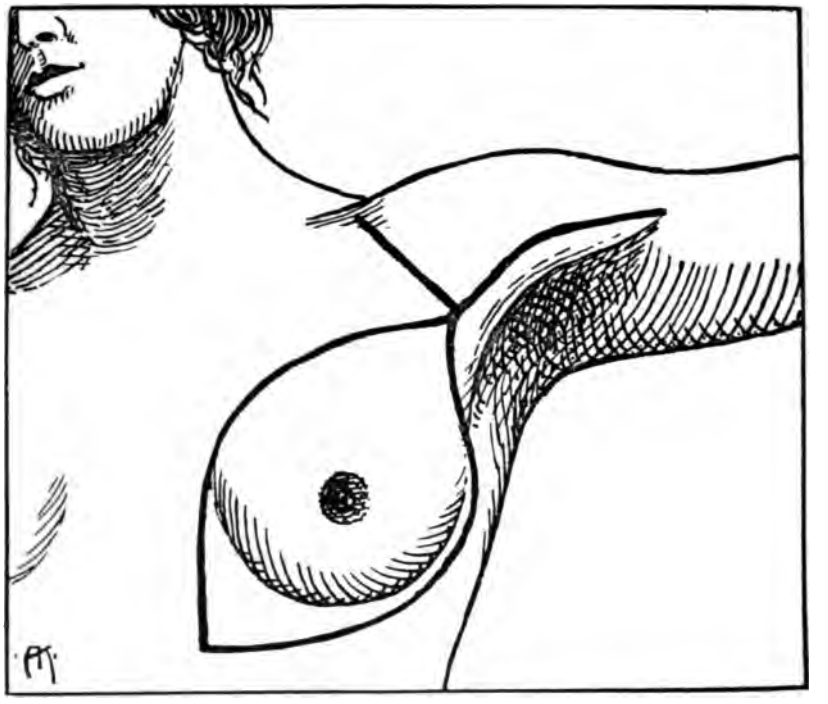

Fig. 308.—Lines of incision in removing the breast. If the arm incision is carried well over the pectoral muscle the cicatrix will not fall in the axilla and the patient will have much less pain and hindrance in moving the arm.

axilla around the upper border of the breast and below to the center line. This incision is deepened and carried upwards beneath the skin until it reaches the pectoral fascia. The breast, including the pectoral fascia, is then rapidly dissected from the chest wall, until the lower border of the gland is reached, when a lower curvilinear incision is made around lower border of the gland. The gland and pectoral fascia are now only attached at the axillary border. The lymphatics going to the axilla and their surrounding fat are left as a pedicle. The incision is then extended along the upper border of the axilla, the axillary fascia divided and the space cleared of its

contents. This may be done by careful dissection, or by sponge pressu upon the tissues with a bit of gauze it can often be very readily, quickly ar completely stripped of its contents. If the axillary space is specially i volved a perpendicular incision should be carried up to the clavicle throug the skin and pectoral muscles, so as to freely expose the axilla at its ape This is especially necessary in cases in which some of the glands are int mately attached to the axillary vessels. In these cases the pectoral muscl and fascia are also removed. Murphy suggests that a portion of the mu cle, having been relieved of its fascia, be swung in over the axillary vesse and stitched in position, for the purpose of preventing subsequent adhesion After the completion of the operation the wound is drained by making short incision at the posterior border of the axilla and inserting a drainag tube, when the wound is closed by sutures (Fig. 308).

CHAPTER XVI.

ACCIDENTS AND SURGICAL AFFECTIONS OF THE ABDOMEN.

INJURIES TO THE ABDOMINAL WALLS.

These have been divided into three classes, first, contusions; second, non-penetrating wounds; third, penetrating wounds.

Contusions of the abdominal wall are produced by blunt force, and have the same characteristics as contusions situated elsewhere on the body. At times a hæmatoma occurs following a rupture of some blood vessel or a portion of a muscle.

Contusions in this situation are of especial importance, in consequence of the occurrence of severe shock or injury to the abdominal contents. Occasionally an injury to the epigastrium will be followed by profound shock, and perhaps even death, in consequence of over-stimulation or a profound impression upon the solar plexus. As the result of severe abdominal injuries an over-distended stomach or urinary bladder may be ruptured, and as a complication in some of these cases, and especially following the formation of an hæmatoma, infection may occur. There may be some difficulty in differentiating shock from an internal injury in this class of cases. The shock ordinarily is readily recovered from, and is not attended by pain. If any one of the internal organs is injured it will be followed by severe pain, localized or diffused tenderness, with tension of the abdominal muscles.

TREATMENT.—In all cases of severe contusion of the abdominal wall the patient should be put to bed and kept perfectly quiet. An opiate may be administered if the pain is severe. The bowels are ordinarily kept closed for twenty-four or thirty-six hours. If the pain is severe a cold compress or an ice bag should be applied to the abdomen. If there are symptoms indicating rupture of an abdominal organ a laparotomy should be performed at once.

NON-PENETRATING WOUNDS.

The same principles of wound treatment apply here as elsewhere. Primarily hemorrhage should be arrested, then the wound asepticized, provision made for drainage and the wound closed. An incised and perfectly clean wound should be carefully reunited by suture, for the purpose of preventing a subsequent ventral hernia.

PENETRATING WOUNDS OF THE ABDOMINAL WALL.

These wounds are of very great importance, in consequence of the liability of infection, injury to the abdominal contents, and hemorrhage. These wounds in private practice are most frequently the result of accidental or

intentional thrusts with a knife, or they are gunshot wounds. The fact that the abdomen has been opened may be determined by the prolapse of omentum or intestine, or by carefully exploring the wound. In any penetrating wound of the abdominal wall it is primarily of the greatest importance to determine if any of the abdominal organs have been seriously injured. In any case of doubt the wound should be enlarged and carefully explored. If the wound has penetrated the stomach or intestinal canal, or other abdominal viscera, the contents of these organs may appear in the wound and readily establish the diagnosis. There will in almost all cases, if severe injury has been done to some of the abdominal organs, be pronounced shock, excruciating pain, great abdominal tenderness, followed by tympanites, vomiting, and obstinate constipation.

Penetrating wounds of the abdomen which are not followed by injury of the intestinal contents are often attended with very slight symptoms. There may be only localized pain, insignificant shock, and no very marked tenderness, the pulse and temperature being practically undisturbed.

TREATMENT.—The principles of treatment here are to arrest hemorrhage, relieve shock, and asepticize the wound. If internal hemorrhage has occurred, or injury to the abdominal contents or infection appears likely to follow the wound, a laparotomy should be immediately done, the bleeding vessels secured, the injured organs repaired, and the abdomen drained and perhaps washed out. If the surgeon is in doubt in any given case as to whether hemorrhage, severe injury, or infection has occurred within the abdomen, and the symptoms are at all marked, and the facilities for doing a laparotomy are at hand, it is far better to err and do a clean laparotomy and to find that neither hemorrhage, severe injury nor probable infection had occurred than to defer operation in a case of hemorrhage, injury, or possible infection until a diffuse and uncontrollable septic peritonitis has developed, or the patient is beyond relief from hemorrhage.

SUBPHRENIC ABSCESS.

By this is meant a collection of pus adjacent to the diaphragm. The process may be due to a variety of causes, and the pus may be located either within or without the peritoneal cavity (intra-peritoneal or extra-peritoneal). The process is very often due to infection from a chronic ulcer of the stomach. The ulcer may be situated upon the anterior wall, when, if an abscess forms, it will be bounded behind by the stomach and lesser omentum, above by the diaphragm and left lobe of the liver, with the falciform ligament on the right, and by adhesions between the stomach, liver and anterior abdominal wall in front. In this form the pus usually gravitates toward, or points to, the left, and just below the ensiform process. If the ulcer is situated on the anterior wall of the fundus, the pus is likely to be in close relationship with the spleen, and to point beneath the left costal arch. If the ulcer is situated upon the posterior wall of the stomach the pus will be located in the lesser omental sac, and push the stomach forward and reach the surface, if at all near the ensiform process. In duodenal ulcers the pus, if intra- 's bounded by the liver, omentum, colon and anterior eritoneal abscess may be caused by duodenal ulcer,

or an infected appendix. In these cases the pus travels upwards between the liver and diaphragm, or downwards towards the right iliac fossa.

SYMPTOMS.—These will depend in a measure upon the cause. There are pain, tenderness and swelling—the latter most severe at the site of the abscess. Fever is usually marked, and often there are chills; the abdominal muscles will be rigid over the seat of the infection. The liver may be depressed in extra-peritoneal cases situated upon the right side, and when on the left the diaphragm and heart may be pushed upwards.

TREATMENT.—This consists in opening and draining the abscess cavity. The pus may be reached through an anterior incision or be most accessible below the costal arch posteriorly, or may be reached by a transpleural incision, after resection of the eighth and ninth ribs.

ABDOMINAL ASCITES.

By this is meant an accumulation of fluid within the peritoneal cavity. Ascites is but a symptom of disease, and is due to a variety of causes:—cirrhosis of the liver, cardiac affections with incompetency of the heart muscle, chronic Bright's disease, interference with the portal circulation by adjacent adhesions or enlarged glands in the portal fissure, abdominal tumors, malignant or benign, or intra-abdominal pathological processes, which irritate the peritonum. Chylous ascites is a condition in which the fluid is milky from the admixture of chyle, and is usually due to rupturing of the receptaculum chyli. In ascites the fluid is usually free in the peritoneal cavity, but it may be walled off by adhesions into circumscribed areas.

SYMPTOMS.—The abdomen becomes distended, often enormously so. There is fluctuation. The fluid gravitates to the most dependent portions of the abdominal cavity, and distends the lower abdomen and flanks. The intestines float upwards to the epigastric region. Consequently the lower abdomen and sides are dull upon percussion, while the epigastric region is tympanitic. The area of dullness changes upon the patient's turning from side to side. While the patient is upon his back, both flanks and lower abdomen are dull. If he turns upon his left side, the right flank becomes tympanitic, and *vice versa*. This is in consequence of the fluid gravitating to the opposite side.

DIAGNOSIS.—The presence of fluid is readily made out in consequence of the dullness on percussion, and the fluctuation. Ascites which practically fills the abdominal cavity and produces decided enlargement, must be differentiated from cystic tumors, such as a large ovarian cyst. In both of these conditions there is dullness on percussion, and fluctuation. In a cystic tumor, unless the abdominal parietes are very thick, the wall of the tumor can be made out and defined as against the more soft abdominal contents. The area of dullness does not change materially with the changed position of the patient. In a tumor the flanks are usually tympanitic and seldom dull, when the patient is upon his back. The diagnosis should never be thought complete until one has ascertained the cause.

TREATMENT.—This varies with the cause, which should be sought [illegible] and if possible removed. An ascites due to tubercular perito[illegible] drainage of the abdominal cavity. If the ascites is due t[illegible] the ovary, or a malignant tumor within the abdome[illegible]

sible, should be removed. If it is due to a cardiac affection, the heart should be strengthened; if due to chronic Bright's disease this condition, if possible, should be corrected. Ascites in men who have been free drinkers for long periods, is often due to cirrhosis of the liver. In any case if the amount of fluid is excessive, causing pressure symptoms, it should be drawn off. (Paracentesis abdominis.) This is readily accomplished. The patient is seated in a chair or lies at the edge of a couch. The lower abdomen is cleansed, and the upper limit of dullness defined. The patient's bladder should previously have been emptied. The abdomen is encircled with a towel, the ends of which are crossed and drawn upon from behind. A small trocar is now thrust through the abdominal wall in the median line and about three inches above the symphysis. To render this procedure less painful the skin may be frozen with ethyl chloride and then nicked with a knife. In introducing the trocar the handle is held in the palm of the right hand, while the right index finger is placed upon the cannula perhaps three inches from its tip. The trocar is then introduced by a quick movement of the hand. It will be appreciated at once when the point has entered the abdominal cavity, by the loss of resistance. The trocar is then withdrawn, leaving the cannula in place, and the fluid allowed gradually to make its escape. When the cause cannot be relieved, the tapping must be repeated.

In ascites due to cirrhosis of the liver, Talma's operation, epiplopexy, has been extensively practised. The purpose of this operation is to relieve the obstructed portal circulation by establishing a circuitous route with the systemic veins through the omentum and abdominal wall. In carrying out the operation the abdomen is opened above the umbilicus and the omentum stretched out and stitched to the anterior abdominal wall with catgut sutures. The results of this operation while brilliant at times, yet more often have but little to advocate the undertaking of it.

SURGICAL AFFECTIONS OF THE MESENTERY.

WOUNDS.

Wounds of the mesentery are of frequent occurrence in gunshot injuries, and often lead to severe and even fatal hemorrhage. Gunshot wounds of the mesentery are frequently complicated by perforating wounds of the intestines.

Symptoms.—In this class of cases there will primarily be shock and the symptoms of hemorrhage; and following these peritonitis is likely to occur in consequence of the wounds having been infected at the time of the injury, or as the result of peritoneal infection from injury to the bowel.

Treatment.—If there is hemorrhage, this will require immediate attention. The abdomen should be opened and the bleeding vessel or vessels secured. If the injured vessel is one of importance, the vitality of the intestine may be so impaired by its ligation as to require resection of the corresponding portion of the intestine, and an intestinal anastomosis. Coincident with the control of hemorrhage, shock should be alleviated as much as possible by the hypodermic administration of strychnine in full doses, also morphine, caffein and digitalin. If there are any wounds of the in-

testines these should be repaired, the wound and peritoneal cavity asepticized, and the abdomen drained.

THROMBOSIS AND EMBOLISM OF THE MESENTERIC VESSELS.

Thrombosis occasionally occurs in strangulated hernia, requiring resection of the corresponding portion of the bowel Embolism of the superior mesenteric artery is of occasional occurrence. The main artery may be blocked near its origin, or one of its branches may be obstructed. The embolus has its origin either from a vegetation of the valves of the heart or from an aortic aneurism. Thrombosis of the mesenteric veins also occurs. In these cases the thrombus may extend downwards from the liver, or have its origin in an intestinal ulcer or suppurative process within the abdominal cavity.

SYMPTOMS.—The symptoms of thrombosis or embolism of the mesenteric vessels come on suddenly, and are those ordinarily ascribed to obstruction of the bowels. There is severe, often excrutiating, pain, which frequently comes on in paroxysms, obstinate vomiting, constipation, occasional diarrhœa, with tympanites. If there is diarrhœa, the stools are usually blood-stained. If the superior mesenteric artery is obstructed near its origin, the entire small intestine, barring the first part of the duodenum, with the cæcum and ascending colon and perhaps the transverse colon, will become gangrenous. In a considerable number of the cases a branch of the mesenteric artery has been blocked and the gangrene limited. In thrombosis of the mesenteric veins, the process comes on more gradually and is usually limited to some few branches of the mesenteric veins. It is practically impossible to differentiate this condition from obstruction of the bowels, the diagnosis, however, is corrected when the abdomen is opened. The abdominal cavity will then be found to contain a quantity of blood-stained serum, while the implicated intestine will be gorged with blood, and often is black. In case the veins are thrombosed, they can be felt as quite hard, distinct and rigid cords.

TREATMENT.—This consists in resecting the affected portion of the bowel, if this is not too extensive, and in making an intestinal anastomosis.

CYSTS OF THE MESENTERY.

These occasionally occur as lymph or chyle cysts. They are round, tense, fluctuating, rather fixed tumors, directly connected with the mesentery. They are difficult of diagnosis without a laparotomy. Their treatment is the enucleation of the cyst. It can usually be done without injury to the blood supply of the intestine. Should the blood supply in their enucleation be seriously interfered with, a resection of that portion of the bowel affected would be required.

SURGICAL AFFECTIONS OF THE STOMACH.

FOREIGN BODIES.

These consist of plates of teeth, pins, coins, balls of hair, and other foreign substances which have been swallowed accidentally or intentionally. Children often accidentally swallow pins and coins, to the great alarm

their parents. The treatment of this class of cases should be the administration of such food as will form a residue and enclose the foreign body. Bread and potatoes are very suitable for this purpose, and should be administered in large quantities. After from five to ten days the foreign substance will usually be passed, embedded in some hardened feces. In this class of cases it is necessary to avoid the administration of cathartics, because they render the stools liquid and increase peristalsis, which conditions favor the arrest of the foreign body in the intestinal canal. Foreign substances which have reached the stomach and are too large to pass the pylorus, should be removed by operation (gastrotomy).

ULCERS OF THE STOMACH AND DUODENUM.

Ulcer of the stomach may follow a blow or occur in such occupations as shoemaking, washing and tailoring—especially if associated with marked debility or anæmia. Heart and kidney diseases are also predisposing factors. Thrombosis and embolism of the gastric blood vessels are factors in the production of ulcers. Thrombosis may occur during severe attacks of vomiting. Associated with these conditions there is usually a hyperacidity of the stomach contents. Age is also an important factor. Ulcer of the stomach occurs most frequently in anæmic, debilitated women, between the ages of twenty and thirty, while ulcer of the duodenum occurs most frequently in men between the ages of thirty and forty.

It is claimed by Ewald that 5 per cent. of the Germans suffer from ulcer of the stomach. It has also been held that from 1 to 1½ per cent. of Americans suffer from the same condition.

There is usually but a single ulcer, although two or more may occur. The most frequent site is upon the posterior wall near the pylorus and lesser curvature. According to the statistics of Welch, in 793 cases 288 were near the lesser curvature, 235 on the posterior wall, 95 at the pylorus, 69 on the anterior wall, 50 at the cardia, 29 at the fundus and 27 on the greater curvature.

Ulcers of the stomach have been divided into the acute and chronic. The acute ulcer is usually single, small, round and most frequently situated on the posterior wall of the stomach. The ulcer is truncated, each successive coat being destroyed to a lesser degree than the one which preceded it.

Symptoms.—At times acute ulceration will be preceded for a few days by such symptoms as distress, pain and localized tenderness. As a rule there are but two conditions which are indicative of acute ulceration; one of these is hemorrhage, which is often profuse and persistent, and the other is perforation.

CHRONIC ULCER.

The pronounced symptoms of chronic ulceration of the stomach are pain, tenderness, vomiting and hemorrhage. The pain is often characteristic in that it comes on almost immediately after the taking of food. The tenderness is often circumscribed and situated just below or to the right or left of the ensifo[illegible]ilage. The tenderness is increased by pressure. The [illegible] occasionally increased when the stomach is empty, [illegible]peracidity of the gastric contents during this period.

Vomiting is a very frequent symptom and occurs very soon after the taking of food.

Hemorrhage is the most characteristic symptom of ulcer of the stomach. A copious hemorrhage of pure blood is practically pathognomonic of ulcer of the stomach. Hemorrhage occurs in the vomiting of cancer, but it is small in amount, mixed with mucus and usually has the appearance of coffee grounds. When the hemorrhage is profuse blood will be found in the stools. In ulcer of the stomach, the free or combined HCl is usually markedly increased, unless there is at the same time a chronic catarrhal gastritis, in which case the HCl is diminished. In duodenal ulcer the pain occurs less frequently in paroxysms, and is most severe in from 2 to 4 hours after the taking of food. In duodenal ulcer the patient does not vomit so often, and the material vomited less frequently contains blood, while there is more blood in the stools, than in gastric ulcer.

PROGNOSIS.—The deaths from all causes, according to Welch and Mitchell reach 15 per cent. of the cases. With very few exceptions the deaths are caused by perforation or hemorrhage.

TREATMENT.—The medical treatment of acute ulcer of the stomach with severe hemorrhage, is absolute rest, both of the stomach and of the body. The patient should be put to bed, kept quiet, and nourished by rectal enemata. Bismuth is often administered in this class of cases, and also nitrate of silver in pill form, or in solution. A few days after the arrest of the hemorrhage the patient may be allowed to be up and take liquid, non-irritating food, in small quantities.

Surgical treatment of acute ulcer of the stomach may be required for two conditions: One of these is severe hemorrhage, and the other is perforation. Severe persistent hemorrhage, which is not controlled by proper medication, rest and rectal alimentation, may require operation. Operation, however, is usually contra-indicated. If operation is done the bleeding vessel should be secured and a gastro-enterostomy done. This is for the purpose of giving rest to the stomach by drainage.

Perforation (which is denoted by shock, intense pain, diffused tenderness, vomiting and tympanites) requires immediate operation, with closure of the rent, washing out and draining the abdominal cavity. Cases of chronic ulcer in which the symptoms persist or recur in spite of the most careful dietetic and medical treatment, should be subjected to a gastro-enterostomy.

CARCINOMA OF THE STOMACH.

In men cancer affects the stomach more frequently than any other organ of the body, and in women more frequently than any other organ except the uterus and breast.

Cancer occurs most frequently between 40 and 70 years of age. It is more frequent in men than in women in the ratio of 58 to 42 (Brinton). Cancer of the stomach is very infrequent in Egypt, Turkey [illegible] some parts of China.

Hahn in his statistics of 130 cases at the Friedrichsruhe [illegible] states that in 60 of these cases the cancer occurred in t[illegible]

In 27 in the lesser curvature.
In 21 the entire stomach was implicated.
In 8 the greater curvature.
In 7 the anterior wall.
In 7 the posterior wall.
Welch in 1,300 cases found the pylorus implicated in 791.
The cardia in 104.
The lesser curvature in 148.
The entire stomach in 61.
The greater curvature in 34.
The anterior wall in 30.
The posterior wall in 68.
The fundus in 19.
In 45 there were multiple foci.

Cancer of the stomach has been divided by pathologists into three main groups: First, the scirrhous. This is usually situated at the pylorus and is represented by a reasonably circumscribed thickening and induration of its walls. If cut it creaks markedly. The anterior surface is either smooth or marked by inconspicuous elevations and depressions. Microscopically there is but little epithelial tissue, most of the growth being made up of dense fibrous tissue.

ADENO-CARCINOMA—(MEDULLARY CANCER).

This form of carcinoma is also most frequently situated at the pylorus. The tumor often appears as a fungous growth. It is spongy, soft, juicy and very vascular. It usually has a reasonably smooth surface, divided by rounded nodes. Ulceration and destruction of a portion of the mass is likely to occur, leaving a smooth surface. Adeno-carcinoma, or its ulcer, is not only very vascular but bleeds readily, the hemorrhage being often profuse. Microscopically there is a great amount of cellular elements, with comparatively little connective tissue. The arrangement of the cells in the spaces is more or less typical of glandular structure. The cells usually retain their cylindrical form.

SQUAMOUS EPITHELIOMA.

This form of carcinoma when occurring at the cardiac extremity of the stomach, is an extension from a squamous cell epithelioma of the lower end of the œsophagus, and usually occurs as a hard, thickened, progressive, elevated ulcerating surface. The borders and base are very hard.

In the growth of carcinoma of the stomach the clusters of cells come to invade the submucous and muscular walls. The serous coat is also frequently invaded. The lymphatic vessels upon the serous surface are often distended with plugs of cancer cells. The glands along the [illegible] curvature are first affected. Then the gastro-hepatic omentum may [illegible] thickened and contracted. The gastrocolic omentum is [illegible] and cancerous adhesions between the stomach and [illegible] astric cancer is less malignant than cancer of the [illegible] stases occurring at a later period.

There is now no question but that ulcers of the stomach are frequently the cause, directly or indirectly, of carcinoma, in that the process becomes engrafted upon an ulcer, or is caused by the irritation of the cicatricial tissue formed during the healing process. A very frequent cause, apparently, of carcinoma of the stomach is the dyspeptic or catarrhal condition produced by improper food and alcoholic drinks. Here, as elsewhere, anything which produces and maintains an irritation and which increases the blood supply, is likely to lead to cell-proliferation, and in the end may be a causative factor of carcinoma. It is claimed that in more than 70 per cent. of the cases of gastric carcinoma the patients have been steady drinkers of spiritous liquors.

SYMPTOMS AND COURSE.—The symptoms of carcinoma of the stomach when not situated at the cardia may make their appearance suddenly, or steal on the patient so insidiously and gradually that he is unable to determine the time of their first appearance. The first symptoms ordinarily are those which are usually ascribed to dyspepsia. After meals there is pressure and fullness in the stomach [illegible] of gases. Then comes loss of appetite, nausea and vomiting [illegible] thirst and constipation [illegible] great. The [illegible]

present. The absence of free HCl is noted in chronic gastritis, in atony of the stomach, and in certain nervous affections.

The presence of lactic acid in the stomach contents is also of diagnostic worth. This acid is the result of fermentation produced by micro-organisms upon the carbohydrates and is practically always present in cases of obstruction of the pylorus by carcinoma. The Opler-Boas bacillus occurs in lactic acid fermentation and is to a certain extent characteristic of carcinoma of the stomach. It may occur, however, in a case of benign stenosis, with impaired motility.

Progressive emaciation is one of the most characteristic features of this disease. It is quite true that in some exceptional cases it may not be continuous. Patients may have periods during which they will not only lose weight, but even make considerable gains. On the whole, however, the loss of weight is continuous, and in the course of a few months will reach from 20 to 30 pounds or more. The loss of strength usually keeps pace with that of weight, the patient finding himself becoming progressively weaker from month to month.

It is claimed that 15 per cent. of the patients suffering from carcinoma of the stomach have an elevation of temperature. This may reach 101° F. or even more. The rise, however, is usually of short duration.

The bowels are constipated in consequence of the failure of much of the ingested food to gain an entrance into the intestinal canal. The urine often shows indican, acetone, albumen and even casts.

As the result of the inability of the patient to take and assimilate food, and in consequence of toxæmia, the red blood corpuscles in carcinoma of the stomach are always reduced, not infrequently falling as low as two million per c. mm. The hæmoglobin is reduced in about the same ratio, averaging about 40 per cent. The leucocytes are not materially changed.

In a short résumé of the important symptoms and conditions indicative of carcinoma of the stomach one would expect the patient to be between 50 and 65 years of age, and to complain of distress or pain in the epigastric region after eating. With this there is loss of flesh and strength. With the progress of time the pain increases, becomes considerable, and is soon associated with vomiting which is progressively more frequent. The ejected material is considerable in amount and often has a coffee-ground appearance. A chemical examination of the stomach contents will show an absence of HCl, the presence of lactic fluid, with the Opler-Boas bacillus.

In cases of carcinoma of the pylorus a narrowing of its lumen will occur; the stomach will become markedly dilated. A tumor may be detected during some part of the course of the disease in 80 per cent. of the cases. The right rectus is often tense. The ankles are frequently swollen, and an examination of the blood will show a diminution of the red blood corpuscles. Tumors which take origin from the pylorus are usually found to the right of the median line, while those which take origin from the greater or lesser curvature of the stomach, or the cardia, are situated to the left of this line. Gastric tumors which are not confined by adhesions are usually very movable. This is especially true of tumors situated in

the body or fundus of the stomach. They may often be pushed to almost any position in the upper abdomen.

DIAGNOSIS.—Carcinoma of the stomach should be differentiated from chronic ulcer, which may occur in middle life or at an advanced age. Chronic ulcer usually occurs at an earlier age, is frequently attended with vomiting of bright red blood, the free HCl is usually increased, and there are frequently periods of apparent healing of the ulcer.

Pernicious anæmia may be mistaken for insidious cancer in that both present dyspeptic symptoms, distress after eating, disgust of food, nausea, vomiting and an elevation of temperature. In pernicious anæmia, emaciation does not occur, and the red blood corpuscles even fall below one million per c. mm.

Cancer of the stomach must also be differentiated from chronic gastric catarrh and from so-called nervous dyspepsia. In chronic gastritis free HCl is usually diminished. There is distress after eating. But a proper regulation of the diet for two or three weeks, with suitable medication, will at least relieve or produce decided improvement in the patient's condition. In so called nervous dyspepsia there is often distress after eating, diminution of free HCl, but there is seldom vomiting. The patient is very nervous, sleeps badly, there are often causative factors which are indicative of the trouble, and a proper regulation of the diet with tonics usually gives relief in one or two weeks.

Diagnosis of carcinoma of the stomach is made insofar as it is possible by considering the symptoms and course of the disease and making a chemical examination of the stomach contents after a test meal, regulating the patient's diet and making a physical examination of the abdomen.

PROGNOSIS.—Prognosis of carcinoma of the stomach without operative interference is absolutely hopeless.

TREATMENT.—The treatment of carcinoma of the stomach consists in excising the tumor at the earliest possible moment that a diagnosis can be made.

SIMPLE STENOSIS OF THE PYLORUS.

This is caused by a number of pathological conditions: First, the healing of a gastric ulcer may cause such contraction as to produce stenosis. Spasms of the walls of the pylorus occasionally occurs as the result of hyperchlorhydria in case of pyloric ulcer. Stenosis may result from the contraction of adjacent adhesions which stretch across the pylorus. This has often been known to occur following operations upon the gall-bladder. These adhesions may also form subsequent to the healing of the pyloric ulcer. Stenosis may also occur as a congenital hypertrophy of the pylorus.

PHYSICAL SIGNS.—Following stenosis there is hypertrophy and dilatation of the stomach. The organ may become so enlarged as to be capable of holding several quarts of fluid. In extreme cases the greatest curvature may reach the pelvis. Food collects within the stomach, undergoes fermentation and is finally ejected in large quantities. Splashing sounds are often heard on quickly prodding the abdominal wall over the stomach, and waves of fluctuation can often be elicited by tapping the abdominal wall. The contour of the organ can very readily be mapped out by percussion, by three

splashing sounds, and by the waves of fluctuation. At times its outline can be very distinctly seen.

TREATMENT.—As palliative treatment the stomach should be washed out once each day with sterilized water, bicarbonate of soda or boric acid solution. The stomach may also be massaged and its tone be improved by electricity and strychnia.

When the stenosis is marked and requires more than palliative treatment, (1) The stomach may be opened and the pylorus dilated with the finger (Loreta's operation); (2) The pylorus has been excised for simple stenosis, but this is not practised at the present time; (3) Pyloroplasty has been practised. This consists in making a longitudinal incision an inch and a half or two inches long through the stricture and converting this incision into a perpendicular one by making traction upon the center of each wall with a tenaculum. This perpendicular incision is then united by suitable tier sutures.

At the present time in cases of severe stenosis of the pylorus a gastro-enterostomy is usually done, the stomach being united to the upper portion of the jejunum.

ACUTE DILATATION OF THE STOMACH.

This may occur following injuries or operations which are not necessarily confined to the abdomen. Among the first symptoms is the vomiting of enormous quantities of liquids, with acute general prostration. The process usually ends fatally.

The treatment advised is the washing out of the stomach, the use of electricity and strychnine.

CHRONIC DILATATION OF THE STOMACH.

Dilatation of the stomach is caused: (1) by stenosis of the pylorus; (2) by atony of the muscular coats of the stomach. The latter condition may be due to repeated over-filling of the viscus with solids or liquids, or to chronic gastritis; (3) it is often due to chronic gastric catarrh, in association with over-eating and drinking.

SYMPTOMS.—These are variable, depending somewhat upon the cause. There is usually heaviness and a feeling of distress in the stomach. The patient often has a voracious appetite and eats and drinks freely.

The most characteristic symptom is the vomiting, at intervals, of large quantities of liquids. The fluid vomited is sour, and usually of a dark color. The bowels are constipated in consequence of the small amount of fluid which passes the pylorus.

The abdomen is usually enlarged, and the abdominal wall frequently pendulous. The outlines of the stomach can frequently be seen. Peristalsis can often be both seen and felt, and splashing sounds and waves of fluctuation are usually present. The area of dullness when the stomach is filled with fluid, is greatly enlarged and can readily be mapped out on percussion. On the withdrawal of the fluids from the stomach by siphonage, this dullness practically disappears.

DIAGNOSIS.—This is made by considering the possible cause, the symptoms, by physical examination of the abdomen, and by withdrawing the fluid

TREATMENT.—This will depend upon the cause. If it is due to stenosis of the pylorus this condition should, if possible, be relieved. If there is a cancer present, the pylorus should be resected. If the dilation is due to atony, the diet should be regulated, small quantities of liquids being given at frequent intervals, and the patient treated with electricity and given strychnine internally. If there is chronic catarrh, the stomach should be washed out each day. Washing the stomach is readily accomplished with a little tact. The patient should sit upon a stool and have a large towel placed about the neck. The lap should be covered with a spread. The tube of a stomach-pump, after being asepticized, is well anointed with vaseline and while the patient holds the mouth wide open it is carried over the tongue down into the pharynx, and the patient directed to swallow. With each act of swallowing the tube is pushed down towards, and finally into, the stomach. In passing the tube for the first time, the retching is frequently severe, and the tube is often expelled instead of being swallowed; but with a little patience and perseverance one will soon succeed in this operation. When the tube has once reached the stomach, it is very desirable that retching be avoided. The patient may be instructed to support the tube and prevent its expulsion by taking hold of it near the mouth. The funnel-shaped end of the tube is then raised above the patient's head, and a warm solution of boric acid, or bicarbonate of soda, slowly poured into the funnel. The pouring is continued until the stomach is filled. The patient may be instructed to make some sign, such as raising the unoccupied hand, when he feels that his stomach will not contain more fluid. The siphon is then depressed into a slop-jar at the patient's feet, and the stomach emptied. This process may be repeated two or three times, or until the stomach is quite clean. The act of washing the stomach removes the weight of the accumulated fluid, and allows the organ to contract. It gets rid of fermenting and excessively sour food and liquids, and thus relieves the stomach of much irritation. It also cleanses the stomach by washing the mucus from its walls. Washing the stomach is not only advisable in cases of dilatation with accumulation of fluid, but it should be practised before operations upon the part.

[illegible]

GASTROTOMY OR INCISION OF THE STOMACH

[illegible]

body is removed, or the pathological condition corrected. The wound in the stomach is then closed by continuous tier suture.

GASTROSTOMY.

This consists in making a permanent artificial opening in the stomach for the purpose of feeding the patient in cases of malignant disease, or in intractible stenosis of the œsophagus. The abdominal incision is made two or three inches from the border of the left costal cartilages. A cone-shaped piece of the anterior wall of the stomach is drawn through this incision and the parietal peritoneum and that of the stomach united by a continuous suture all around the base of the cone, so as to shut off the general peritoneal cavity from possible infection. A second incision, about one inch long, is then made directly over the costal arch, and the skin and superficial fascia raised between the two incisions. The cone of the stomach is then drawn under this bridge of skin and fascia, and out of the second incision. The stomach is then opened and its mucous membrane accurately stitched to the skin. The first incision is then closed. This makes a valvular opening which tends to prevent regurgitation. The patient may be fed at once through the artificial opening.

PYLORECTOMY AND GASTRECTOMY.

By the former term is meant excision of the pylorus, and by the latter, excision of some portion of the stomach. In gastrectomy the pylorus and some portion of the stomach are usually excised. Complete gastrectomy has been successfully performed in a few cases.

Gastrectomy, as performed for malignant disease at the pylorus, is usually carried out as follows: A free abdominal incision is made above the umbilicus and the stomach drawn into the wound, the abdominal cavity being protected by gauze packing. The blood supply of that portion of the stomach to be resected should then be controlled. Ordinarily the coronary artery is double-ligated on the lesser curvature of the stomach, after it has given off its œsophageal branches. Then the pyloric branch of the hepatic is double-ligated near the pylorus. The gastro-hepatic omentum corresponding to the area to be excised, is then double-ligated and divided. Following this the vessels of the greater curvature of the stomach are ligated. These are the gastro-epiploica sinistra and the gastro-epiploica dextra. Following this the gastro-colic omentum is double-ligated and divided. The gastro-hepatic and gastro-colic omentum should be removed as far as practicable from the greater and lesser curvatures, so as to include as much as possible of the lymphatic and glandular systems which surround the stomach. Under ordinary conditions about two-thirds or three-fourths of the lesser curvature and about one-third of the greater curvature is removed. The duodenum is then clamped off and divided between two pairs of forceps. The incision is usually placed about one inch below the pylorus and should be well below the infiltrated area. The stomach end of the pylorus is then protected by gauze, and turned out of the wound, while the duodenal portion is securely closed primarily by a purse-string suture and then by a continuous suture. The stomach distal to the growth is then double-clamped and divided between the forceps.

The growth is now free and with the affected portion of the stomach removed. The end of the stomach is enclosed by two or three continuous sutures. The first may include all the coats or may simply include the mucosa. The last usually picks up the serous and something of the muscular coats, folding in and hiding the suture line previously made. After the placing of the first continuous suture the forceps may be removed and any bleeding points controlled by interrupted sutures. Following this the end of the stomach is carefully cleansed and a gastro-enterostomy performed. This operation is done in cases of gastrectomy for cancer, for benign stenosis of the pylorus, for hæmorrhage, and for dilatation of the stomach. Anastomosis may be made to either the anterior or posterior wall of the stomach.

In doing a posterior gastro-enterostomy the omentum and transverse colon are drawn out of the abdominal wound and the peritoneal cavity protected by gauze packing. An opening is then made through the transverse mesocolon and the posterior wall of the stomach drawn through this opening. A fold of this wall is then clamped off, which extends from near the cardia and lesser curvature to the lowest practical point on the greater curvature. The jejunum is then drawn along the clamped portion of the stomach, and a longitudinal fold clamped off. The lower borders of the serous surfaces of the jejunum and a stomach are approximated by a continuous suture of silk. The stomach and bowel are opened for two inches, and the approximating surfaces of these incisions united by a through-and-through continuous suture of silk. Following this the distal borders of the wound are also approximated by a through-and-through continuous suture; and then a continuous suture is placed, uniting the upper serous surfaces of the stomach and bowel; this suture corresponding to the one first placed. The clamps are then removed and the abdominal wound closed.

SURGICAL AFFECTIONS OF THE INTESTINES.

Congenital affections of the intestine are occasionally met with. The most frequent of these is Meckel's diverticulum. This is an outgrowth from the lower part of the ileum. It corresponds in appearance with the intestine and usually is a blind pouch several inches long, its proximal extremity being in direct communication with the ileum, while its terminal end may be free, floating as it were among the intestines. Meckel's diverticulum is the result of a non-obliteration of the omphalo-mesenteric duct, and may remain open as far as the umbilicus, causing a fecal fistula, or its terminal portion may be obliterated into a fibrous cord. Meckel's diverticulum is of great importance on account of its liability to cause obstruction of the bowels. Its free end often becomes adherent to adjacent intestines or to the parietal peritoneum, forming a loop beneath which or over which coils of the intestine may be caught and strangulated. It also not infrequently becomes wound around a loop of intestine, causing strangulation and obstruction of the bowel. The condition cannot be diagnosed except by opening the abdomen. Surgical interference is unnecessary except for strangulation. If obstruction occurs, the abdomen should be opened, the coil of intestine liberated and the diverticulum removed at its origin from

the bowel. This leaves an opening in the bowel which should be closed by suitable sutures. A congenital stenosis may also occur in the duodenum opposite the entrance of the common bile duct, or in the ileum at the site of origin of Meckel's diverticulum.

FOREIGN BODIES IN THE INTESTINE.

A variety of foreign substances have been found in the intestinal canal, causing either acute or chronic obstruction, or a fecal fistula. A large gall stone may ulcerate its way through the gall bladder and into an adjacent and adherent intestine, and in consequence of the bowel becoming coated with inspissated fecal matter, reach such a size as to cause obstruction in the lower part of the ileum.

Enteroliths, composed of inspissated feces, and phosphate of lime, vegetable matter, hairs and mucus may reach such dimensions as to produce obstruction of the bowels.

Quite recently, while operating for a vaginal-fecal fistula, a surgeon encountered in the sigmoid flexure a large piece of gauze packing which had been left in the abdomen during a laparotomy. The piece of gauze had caused a pelvic abscess and had then ulcerated its way into the sigmoid. A few weeks following this there was extracted from the rectum of another patient a large piece of sponge packing which had also been left in the abdomen several months previously during a laparotomy, and which had worked its way into the bowel. Both women fortunately recovered.

Foreign bodies intentionally or accidentally swallowed may pass the stomach and become arrested in the ileum.

SYMPTOMS.—The most frequent symptoms are those due to obstruction of the bowels. The obstruction usually comes on gradually with colicky pains, often associated with diarrhea. Perforation of the bowel may also occur, causing death or the formation of a fecal fistula.

TREATMENT.—If obstruction occurs, a laparotomy will be required, with an incision in the intestine and the removal of the foreign body. Following this the intestinal and abdominal wounds are closed.

COLITIS.

This may be caused by chronic constipation, coarse food, bacterial invasion, the amœba coli, or the condition may occur as a sequence of dysentery or diarrhea. In the milder cases there are loose bowels, colicky pains and tenderness along the colon. The feces contain quantities of mucus. In the more severe cases ulceration of the colon occurs. In these the diarrhea is more severe, the stools containing mucus, pus and often blood. The pus may be considerable and the passages very offensive. Stenosis may result from the healing of these ulcerations. The patients often become much emaciated.

TREATMENT.—This should consist in regulating the diet, the food being bland, non-irritating and easily digested, and should be largely of milk, meat-juice and possibly breakfast foods. In cases which do not yield to a regulation of the diet, proper medication and colonic flushings, a fistulous tract may be established in the cecum or appendix, through which the bowel may be regularly washed out.

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The ileum may be opened in cases of obstruction in the large bowel. The operation is not often performed, but may be carried out by opening the abdomen, bringing a suitable coil of intestine into the wound, where it is stitched, shutting off the general peritoneal cavity, and then opening the bowel.

ENTEROPLASTY.

This operation is done for benign stricture of the intestine. A longitudinal incision is made in the intestine at the site of the stricture and opposite its mesenteric attachment. The incision is then opened out and converted into a transverse opening, and sutured while in this position.

COLOSTOMY OR COLOTOMY.

By this is meant the establishment of an artificial opening into the large bowel. The operation is frequently performed for non-operable carcinoma of the large intestine, and for ulcerative colitis. It may also be performed for congenital closure of the rectum, for vesico-rectal fistula, and for syphilitic ulceration or stricture of the rectum. A temporary or permanent fistula may be established, depending upon the process to be relieved. In non-operable cancer of the rectum, with obstruction, the opening is made in the sigmoid flexure or in the descending colon. For the purpose of avoiding the peritoneal cavity, the operation was formerly carried through the left lumbar region (left lumbar colostomy). In this operation the descending color is reached through a perpendicular incision along the outer border of the erector spinæ muscle, or through an incision beneath and parallel to the lower ribs. The colon is recognized, brought into the wound, stitched, and after two or three days, opened. If the case is urgent the bowel may be opened at once. At the present time, in cases of inoperable carcinoma of the rectum with obstruction, the lower portion of the colon or the sigmoid flexure is reached through an anterior incision placed internally to the anterior superior spinous process of the ileum, and perpendicular to a line drawn from the spine to the umbilicus. The bowel is drawn into the wound, fixed, and after two or three days, opened. In cases in which the obstruction is situated higher up, the transverse colon, or even the cæcum, may be opened.

ENTERECTOMY, OR EXCISION OF A PORTION OF THE BOWEL.

The operation is practised for a number of pathologic conditions—benign stricture, multiple perforations, cancer, gangrene and fecal fistula. The portion of the bowel implicated is brought into the wound, the general peritoneal cavity protected, the affected portion of the bowel clamped off on each side, and then excised. Following the excision an end-to-end or side-to-side anastomosis may be made. Union may be effected by means of sutures or by means of the Murphy button.

AFFECTIONS OF THE PERITONEUM.

PERITONITIS.

This may be acute or chronic, localized or diffuse, protective or rapidly fatal in its results.

ETIOLOGY.—As a rule, peritonitis is due to the entrance into the peritoneal cavity of pyogenic micro-organisms, or the bacillus of tuberculosis. It may, however, be due to traumatism or to chemical action.

Acute, diffuse peritonitis is most frequently caused by a rupture of the appendix and the discharge of its contents into the peritoneal cavity. The infection in this class of cases is most often caused by the bacillus coli communis, the streptococcus pyogenes or the staphylococcus pyogenes aureus. The infection may be a mixed one, two or more of these micro-organisms being present in the exudate. Infection may also occur during an operation, or during or following penetrating abdominal wounds, perforating ulcers of the stomach, rupture of an infected gall-bladder, strangulation of the intestine, thrombosis or embolism of the mesenteric vessels, traumatic rupture of some portion of the gastro-intestinal canal, rupture or perforation of the bladder, or uterus, or an infected Fallopian tube.

Chronic peritonitis is frequently due to the bacillus of tuberculosis, and may be localized or diffuse; it is usually secondary to a tubercular process of the genito-urinary organs, intestines, or mesenteric glands.

ACUTE DIFFUSE PERITONITIS.

In this process the peritoneum becomes reddened, the vessels enlarged and prominent, and the surfaces covered with a yellowish plastic exudate, producing adhesions between adjacent serous surfaces. The peritoneal cavity usually contains a quantity of sero-purulent fluid which gravitates into the most dependent areas, such as the pelvis and flanks. The fluid may be quite free in the peritoneal cavity, or walled off into various pockets by the adhesions. The fluid is highly infectious.

SYMPTOMS.—The onset is usually sudden, the pain intense, at first localized and then diffuse and attended with nausea and vomiting. The abdominal muscles are contracted, tense, hard and board-like. Tenderness is extreme, the patient wincing under the slightest touch. The pulse is accelerated and often reaches 110 to 140. The temperature rises and may reach 102° to 105° F.

The respirations are shallow and frequent; the patient is unable to retain anything on his stomach, and frequently ejects small or large quantities of a greenish fluid. The bowels are obstinately constipated, not even gas being expelled. The abdomen becomes markedly tympanitic in consequence of the paralysis of the muscular coat of the bowels with distension of the intestines by gas. As the case progresses, the pulse becomes more rapid and thread-like, the face pinched, the eyes sunken and the extremities cold. Death results from exhaustion and toxæmia. Ordinarily acute diffuse peritonitis will cause death in from five to seven days. In extraordinarily acute cases death may occur in from 24 to 36 hours.

DIAGNOSIS.—The diagnosis of a commencing acute, diffuse peritonitis is not always easy. It will depend upon the probable cause, diffuse pain, tenderness and tension of the abdominal muscles. Rigidity of the abdominal muscles, associated with pain, tenderness, fever, rapid pulse, vomiting and constipation are practically pathognomonic of the disease. Hæmorrhage into the peritoneal cavity may cause in a measure the same symptoms, but in hemorrhage there is likely to be greater pallor, while the fever,

vomiting and constipation are not so pronounced. It will be difficult to differentiate a localized peritonitis with infection from a commencing diffuse peritonitis, with perhaps repeated careful examinations and a close scrutiny of the symptoms.

PROGNOSIS.—It should be remembered that all cases of peritonitis are primarily local, and that unless the process is arrested by a protective wall of omentum and intestines, or by surgical interference, it quickly spreads and becomes general, and is then often fatal. Localized peritonitis, or commencing general peritonitis without intestinal paralysis, is usually amenable to surgical treatment. General septic peritonitis with paralysis of the bowels, as shown by constipation and uncontrollable vomiting, is almost uniformly fatal.

TREATMENT.—The principles of treatment of acute, diffuse peritonitis are to remove or correct, as far as is possible, the cause, and asepticize and drain the peritoneal cavity. Under ordinary conditions operative measures must be undertaken during the first 12 to 24 hours following the inception of the process, if the patient's life is to be saved. In fact, the nearer the operation approximates the infection, the greater the patient's chances are for recovery. If the operation is undertaken before paralysis of the bowels supervenes, as shown by persistent vomiting, obstinate constipation and tympanites, the chances for recovery are good. If paralysis of the bowels has occurred, there is scarcely any chance of saving the life of the patient.

Operative Technique.—If the inflammation is due to a ruptured appendix, the abdomen should be opened by an incision an inch and a half or two inches long, placed below the umbilicus and near the right border of the right rectus muscle, and the appendix removed. Two large drainage tubes, perforated only at their lower ends, are then introduced to the bottom of Douglas' cul-de-sac and through these are passed two or three gallons of a solution of acetozone of the strength of 1 to 10,000. Following this a large dressing is applied and the patient put to bed in a sitting posture. During the next 24 or 36 hours the abdomen should be washed out several times with the same solution while the patient is in a recumbent posture; after the washings he should again be placed in a sitting posture.

ACUTE, LOCALIZED PERITONITIS.

This process usually arises as the result of pyogenic infection of some one of the abdominal viscera. The infection is of such a nature as to allow the organ inflamed (as the appendix, gall-bladder or Fallopian tubes) being shut off from the general peritoneal cavity by adhesions.

SYMPTOMS AND COURSE.—There is severe pain, often nausea and vomiting, localized tenderness, tension of the overlying muscles, rapid pulse and high fever. If the process continues for more than two or three days a tumor is formed by the accumulation of fluid and the matting together of the intestinal coils and omentum into a protective wall about the inflamed area. The fluid being infected, pus forms about the appendix, and the tumor constantly increases in size, and finally bec
dominal wall and presents indications of deer
a week or ten days will be required to p

fetal head, and one presenting fluctuation and attached to the abdominal wall. Not infrequently such a localized peritonitis will undergo resolution.

TREATMENT.—The bowels should be unloaded, rest enjoined, liquid food administered by the stomach, or the patient nourished per rectum. An ice-cap may be applied locally and the pain relieved by the administration of opiates. If pus forms, the abscess should be incised and drained.

SIMPLE CHRONIC PERITONITIS.

A localized form of chronic peritonitis frequently occurs about the appendix, Fallopian tubes, gall-bladder, and abdominal tumors. There is usually some pain, localized tenderness, with such fever as would accompany the original pathologic process. This form of peritonitis is protective and requires no other treatment than for the original disease.

CHRONIC TUBERCULAR PERITONITIS.

It is claimed that in 15 per cent. of the cases of pulmonary tuberculosis the peritoneum is involved. It is generally held, however, that tubercular peritonitis is, as a rule, secondary to tubercular process in the genito-urinary apparatus, in the intestinal canal, or in the mesenteric glands. Tubercular peritonitis occurs in one of two forms, the ascitic and the fibrous. In the ascitic form the peritoneum becomes hyperæmic, thickened and studded with tubercles, while the abdomen is filled with a straw-colored or milky fluid. Not infrequently the fluid, in consequence of intestinal adhesions, becomes walled into cystic cavities, which may readily be mistaken for ovarian cysts. In the fibrous variety the intestines become matted together by adhesions between which foci of tubercles are to be found.

SYMPTOMS.—These will vary with the pathologic condition. The process most frequently affects women, causing anæmia, and loss of appetite. There are usually frequent attacks of diarrhœa, pain in the abdomen and a slight hectic fever. In the ascitic variety a physical examination will disclose a quantity of fluid within the abdominal cavity. The abdominal wall is tender and somewhat tense in consequence of muscular contractions. If the quantity of fluid is not great, possibly irregular nodes may be felt within the abdomen, which represent the coalescence of a great number of tubercles, with the matting together of folds of omentum or coils of intestine.

In the fibrous form there is an absence of fluid, while hectic fever, tension, tenderness of the abdominal wall and muscular contraction are present. Irregular nodes can also frequently be felt, in consequence of the coalescence of innumerable tubercles, usually situated within or upon the omentum, mesentery or pelvic organs.

DIAGNOSIS.—This will rest upon the history, the patient often being tubercular, upon the patient's general appearance, upon the symptoms and a physical examination of the abdomen and chest.

PROGNOSIS.—It has been claimed that 75 per cent. of the ascitic and 60 [illegible] the fibrous cases recover under proper treatment. In my opin- [illegible] convey an entirely too optimistic view. The majority of [illegible] the local disease or from general systemic infection. [illegible] patient should receive the general treatment which [illegible] appropriate for tubercular cases. Exercise is re-

[illegible]

[illegible]

APPENDICITIS.

[illegible]

[illegible] branch [illegible] and it fre- [illegible] the appendix, with [illegible] course, fre- [illegible] this point poorly [illegible] and gangrene.

[illegible] consequence [illegible] diarrhœa are [illegible] extend into [illegible] retention of its [illegible] arrested in the [illegible] and injuries are [illegible] most frequent causes [illegible] into the cæcum. The [illegible] and kinks, its approximation to the cæcum [illegible] adhesions, swelling of the mucous membrane, and the [illegible] bodies, all favo[illegible] etions within the ap-

pendix, and with this retention, infection and inflammation are almost certain to occur.

PATHOLOGICAL ANATOMY.—In inflammation the appendix is enlarged, thickened, the mucous membrane, and often the muscular coats, infiltrated with leucocytes and a plastic exudate. If the process reaches the peritoneal coat this will become hyperæmic, the capillaries being unusually prominent and the peritoneal covering the site of a fibrous exudate with adhesions. In chronic cases there are usually numerous adhesions, while the appendix is thickened and indurated from the organization of the exudate into fibrous or connective tissue. In some cases the lumen becomes partially or completely obliterated as a result of the destruction of a portion of the mucous membrane and the subsequent contraction of the newly-formed fibrous tissue. Ulceration may be the result of the traumatism of concretions, or of pyogenic, typhoid or tubercular infection.

In extra-acute cases the appendix often becomes gangrenous. This is due either to an extra-acute infection or to the rotation of the appendix upon itself, in consequence of which the mesenteric blood vessels become occluded. The appendix very frequently becomes perforated following a severe infection of its walls, the presence of a concretion, or the over-distention of its lumen with pus. In the great majority of cases of perforating appendicitis a fecal concretion is to be found either at the site of the perforation or within the abscess. In a case recently operated upon, the appendix was found to be perforated near its extremity by a concretion and had sloughed completely off at its attachment to the cæcum, leaving in the latter viscus a large, round opening. The appendix still retained its mesenteric attachment.

SYMPTOMS AND COURSE.—For purposes of clinical consideration, appendicitis may be divided into the acute and chronic forms. The acute is subdivided into the acute recurrent, perforating and gangrenous; the chronic, into the simple chronic appendicitis and chronic appendicitis with acute attacks.

In acute appendicitis the process comes on suddenly, with severe pain, most frequently located in the epigastric or right iliac region, although it may be situated anywhere within the abdomen. If the pain is not primarily in the right iliac region, it usually becomes most severe at this point within 24 hours. With the onset of the attack or during an exacerbation, nausea or vomiting are likely to occur. Almost coincident with the occurrence of the pain the right iliac region becomes tender on pressure and the muscles overlying this area are contracted, tense and board-like. The temperature usually rises to 100° or 102° F., and the pulse to 100 or 110 beats per minute. The acute symptoms continue for from 24 to 48 hours and may then gradually subside. The local tenderness and muscular tension are the last symptoms to disappear, and they usually continue for from five to six days. In mild attacks the patient is well and out of the house in a week or ten days, and may never have a second attack. The occasion for the non-recurrence is probably the absence of adhesions and the further and more important fact that the appendix is well drained. In the great majority of cases, however, there are recurrent attacks of greater or less severity, and coming on after longer or shorter intervals. The intervals between the attacks may be but a few weeks, months, or years.

In any of the attacks the appendix may rupture, resulting in a diffuse peritonitis, or the formation of a localized abscess; or an abscess may form without the rupture of the appendix, the micro-organism passing through its walls in sufficient numbers to cause pus formation.

In a large percentage of the cases of acute appendicitis during the first, second or third day, the patient will experience a sudden, violent, excruciating pain in the right iliac region, attended with nausea and vomiting, followed by an increase of all of the previous symptoms.

These symptoms are indicative almost without exception of rupture of the appendix. If the appendix at the time of the rupture is surrounded by a strong protecting wall, made up of omentum, coils of intestine and adhesions, a circumscribed abscess will follow. If the appendix is not thus walled in, a diffuse general peritonitis will result.

GANGRENOUS APPENDICITIS.

In cases of acute appendicitis where the infection is extraordinarily virulent, or in cases in which rotation of the appendix occurs with torsion of its mesentery, gangrene, more or less extensive, will occur. In gangrenous appendicitis the symptoms are usually acute, pronounced and severe, but they are not pathognomonic.

CHRONIC APPENDICITIS WITH ACUTE RECURRENT ATTACKS.

Patients in a goodly number of cases fail to recover completely from an acute attack of appendicitis, and there remains more or less of pain and tenderness in the right iliac region, with tension of overlying muscles. The fever and induration incident to the acute attacks disappear, and while the patient can in a measure continue his work in the intervals, or between the attacks, he is more or less disabled in consequence of the pain and other symptoms being increased by active exercise.

CHRONIC APPENDICITIS WITHOUT ACUTE ATTACKS.

[illegible]

In making the examination to determine the area of tenderness and muscular contraction, the patient should lie upon his back with his knees drawn up and head resting upon a pillow. The examiner should commence by placing the flat of his hand gently upon the left side of the abdomen, and determine by gentle palpation the presence or absence of pain and the softness or tension of muscles upon this side. This is done largely for purposes of comparison. The hand is then gently placed upon the right side and the same process gone through with. In acute appendicitis without general peritonitis, it will be readily determined that while upon the left side the muscles are soft and easily compressed, without pain, upon the right side and over the region of the appendix they are hard and board-like, and any considerable effort to indent the muscles with the tips of the fingers is resisted by the patient and causes severe pain.

Treatment of Acute and Chronic Appendicitis.—No subject in surgery has been so much discussed, and still there is a wide difference of opinion as to the proper treatment of acute appendicitis. My own opinion is that appendicitis is always a surgical affection and that the appendix should be removed, preferably upon the first day of the attack, or upon the first day that the patient comes under observation, with one possible exception, that is, if the patient is seen during the decline of an acute attack it is usually good practice to wait for (the interval operation) a period of about two or three weeks, when the inflammatory process will usually have entirely subsided.

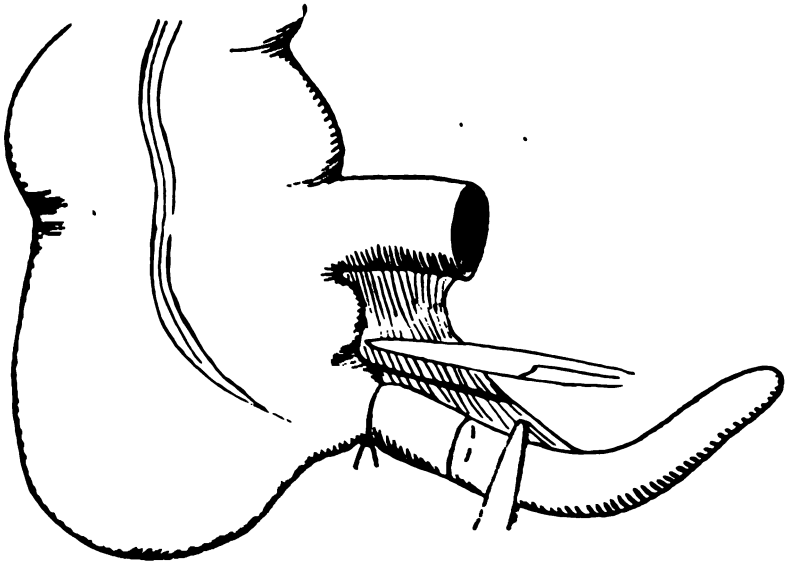
In perforative and gangrenous appendicitis immediate operation is absolutely necessary, if the patient's life is to be saved. If the patient is seen during an acute attack of recurrent appendicitis, the appendix should be at once removed, unless the attack is subsiding. In chronic appendicitis without acute attacks the appendix should be removed, as its presence produces a continued state of invalidism.

It is not advisable, probably would be out of place, to go into the various reasons for these propositions, but at this time and with our present methods of operating, I think they can be successfully maintained. It is practised by many and taught by some that the appendix should be removed during the first or second day of an attack, or that we should wait for the interval operation, but the objection to this treatment is, that in probably a majority of the cases the interval never comes, the appendix ruptures or becomes gangrenous, and diffuse peritonitis is established. But fortunately now this condition can be successfully met in the great majority of cases, if the operation is promptly performed.

Perhaps quite as serious a complication as acute peritonitis, and one more difficult to treat, is the formation of a large abscess whose walls are not attached to the abdominal parietes. In these cases the danger of leakage and the occurrence of secondary abscesses, or diffuse peritonitis, is pronounced, while the amount of gauze packing required to successfully wall off the peritoneal cavity during an operation is often very considerable, subjecting the patient to a long convalescence and to the pronounced risks of septicæmia or pyæmia. In large abscesses, the appendix as a rule cannot be located and should not be removed. The patient consequently must, very often at least, be subjected to a second operation. If one operates

while the collection of pus is small in amount, the abscess is easily dealt with, the appendix removed, and the convalescence short.

Operation on the First or Second Day of an Acute Attack.—The patient is put in the Tredelenburg position and the abdomen opened by an incision two inches long, through the right rectus muscle and below the umbilicus. The position of the appendix can be approximated by noting the area of greatest tenderness and muscular rigidity. For fear that the appendix is surrounded by a small abscess, or will rupture during the manipulations incident to its removal, it is advisable to wall off the appendiceal region by gauze packing. This is readily accomplished by placing a wide retractor in the wound and beneath the left border of the incision, with which the abdominal wall is lifted strongly upwards. The forefinger of the left hand is then passed into the abdomen and over this as a guide gauze packing is placed below in the pelvis all about the left side and above



[illegible] a cuff of peritoneum.

[illegible] gauze three inches wide and [illegible] and hemmed are usually [illegible] identified, pulled into the [illegible] separated and the appendix [illegible] and liberating the ap- [illegible] a small piece of gauze [illegible] appendix, its mesentery [illegible] and then divided. The [illegible] parts are in an aseptic [illegible] of the appendix from [illegible] quarter of an [illegible] toward its [illegible] of [illegible] the

moved at this point, its stump being cauterized with a toothpick which has been dipped in carbolic acid. The peritoneal cuff is then closed with a figure-of-eight stitch, and the mesentery ligated with silk or catgut. If the operation is an aseptic one, the gauze packing is removed and the abdominal wound closed. If there is present a small circumscribed abscess, after removing the small piece of gauze referred to, one end of a piece of washed iodoform gauze is carried down to and packed in the abscess cavity and about the stump of the appendix, while the other end is brought out of the

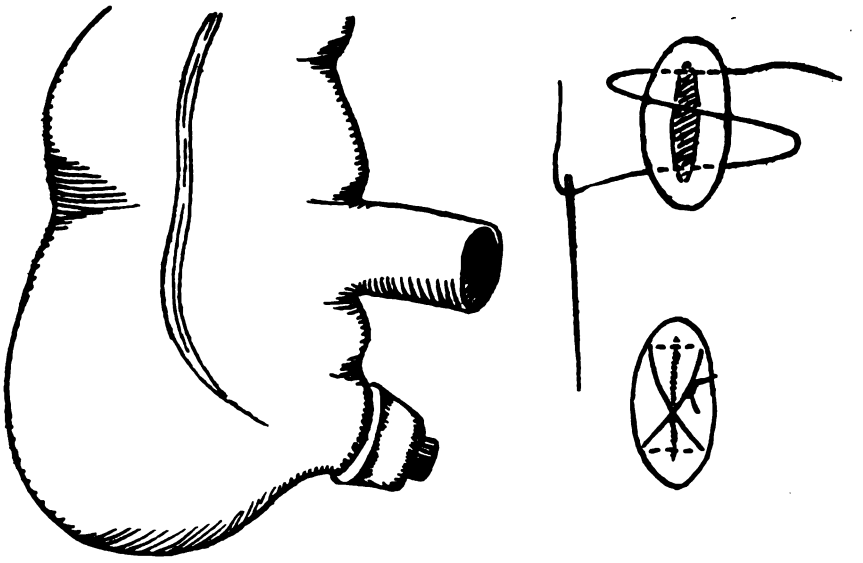


Fig. 310.—Peritoneal flap turned back and appendix removed. The flap is then brought over the stump and its end closed by a figure-of-eight stitch.

wound. At times it may seem best to pack about the cavity and the head of the cæcum a second piece of iodoform gauze. The original packing is then removed, and if thought best the wound narrowed by the insertion of one or more sutures (Fig. 310).

In cases in which drainage is practised, a hot, moist dressing is applied over the wound, and over this a large dry dressing, and a bandage. The dressing should be frequently changed. The patient's bowels should be moved during the third day. The gauze packing is left undisturbed for three days; after this two or three inches of it are withdrawn each day. After the last of the gauze has been removed the wound should each day [illegible]tly irrigated with an antiseptic solution, and following this repacked [illegible] wound has become filled with granulations and the healing is

always an easy matter to locate or remove an appendix; in entirely hidden and buried in adhesions. It may ordinarily

be readily found by defining the cæcum with the ileum entering at a right angle from the left, pulling the cæcum up and carefully separating the adhesions. In some cases the appendix is closely adherent to the undersurface of the cæcum, and this viscus bound down to the iliac fossa, so that neither can be brought into the wound. In these cases the appendix is located by defining its normal position and then finding a hard, indurated area. In the removal it is often best to commence at the base of the appendix, make a peritoneal cuff, and then divide the peritoneum over the appendix longitudinally, and strip it out of its peritoneal investment.

If the case is septic the pouch out of which the appendix has been enucleated should be packed with iodoform gauze, the end of which is brought out of the wound. If the case is aseptic the pouch may be closed by a running suture of catgut.

In an operation for drainage of a large appendiceal abscess which is attached to the abdominal wall, an incision about an inch, or an inch and a half, long is made over the most prominent part of the tumor. The incision goes through the skin and fascia to the muscular layers, which may be separated and the abscess cavity broken into with the handle of the scalpel.

In these cases the tissues of the abdominal wall will be found œdematous and their anatomical structure scarcely recognizable.

Where a large abscess is present, but not attached to the abdominal wall, very thorough packing about the wall of the abscess is required (so as to prevent leakage into the general peritoneal cavity, after the abscess is broken into), by separating the adherent intestine from the wall of the right iliac fossa.

In the cases of abscess two drainage tubes are placed in the abscess cavity, the dressings are frequently changed and the abscess gently irrigated once or twice a day, after the first or second day.

In this class of cases septicæmia or pyæmia may occur in consequence of the virulence of the pus, the fresh wound, and the certainty with which the packing becomes saturated with the discharge. This can only be prevented, in many cases by frequently irrigating the abscess cavity and wound, and withdrawing the packing as rapidly as safety will permit.

[illegible] *Appendicitis. With Commencing* [illegible] In a considerable number of cases the appendix perforates or becomes gangrenous without limiting adhesions having formed. As a result an acute diffuse peritonitis is established. The process is evidenced by the [illegible] tenderness, and tension of the muscles over the [illegible] increase of the temperature and pulse. [illegible] during the first 12 or 24 hours, and before [illegible] peritoneal inflammation has occurred, the results are [illegible] in the great majority of cases, successful. The [illegible] commonly satisfactory has been to open the abdomen [illegible] a short incision, remove the appendix, [illegible] the abdomen which are of sufficient length to [illegible] to the bottom of the [illegible] to wash the abdomen [illegible] one or two [illegible] tubes.

the proper dressing the patient is placed in bed in a sitting posture. These irrigations should be repeated three or four times during the first 24 hours, and at least twice thereafter for several days, the patient being placed during the time of the irrigation in a recumbent posture.

The Closure of an Abdominal Wound.—In the closure of the abdominal wound after a clean appendectomy, the peritoneum should first be united by a continuous suture of catgut: then through-and-through sutures of silkworm gut, which include the skin, superficial and deep fascia and the muscular aponeurosis, are inserted. Before these sutures are tied, interrupted chromicized catgut sutures are inserted through the muscular aponeurosis and between the silkworm gut sutures.

Internal Treatment.—Following an operation for appendicitis, the patient, if weak, should be given rectal enemata consisting of coffee and milk or other suitable liquid food, every three or four hours. Nothing is usually given by the mouth during the first 24 hours, except occasional teaspoonfuls of hot water. Upon the second day a little hot water and milk or tea may be given. If the patient is doing well upon the third day, and after the bowels have moved, considerable nourishment in liquid form may be administered by the mouth. As a rule, during the first 12 or 24 hours, one or more hypodermic injections of codein, ¼ to ½ grains, or morphine, ⅛ to ¼ grain, may be given, to advantage. Strychnin, in doses of 1-40th to 1-20th of a grain, administered hypodermically every three to six hours, is often very serviceable. In clean cases the dressings do not need to be changed until the sixth or seventh day. The silkworm gut sutures are usually removed on the eighth or ninth day, and the patient allowed to get up the latter part of the second week.

INTESTINAL OBSTRUCTION.

By this is meant an interruption of the fecal current in consequence of a blocking of the intestinal canal.

Pathological processes leading to obstruction may be clasified as follows: (1) Impaction of feces, gall-stones or foreign bodies. (2) Strangulated hernia. (3) Volvulus. (4) Intussusception. (5) Constriction of the intestine by bands and adhesions, Meckel's diverticulum or slits in the omentum or mesentery. (6) Obstruction of the intestine in consequence of the growth of a tumor within its walls, or resulting from syphilitic stricture. (7) Paralysis of the muscular coat of the intestine consequent upon peritonitis. (8) Pressure upon the intestine by abdominal tumors. (9) Embolism and thrombosis of the mesenteric vessels. (10) Congenital conditions, and especially imperforate anus or rectum. (11) Ascarides.

Intestinal obstructions may conveniently be divided into the acute and chronic. In the acute form the symptoms come on suddenly, the obstruction [illegible] complete and unless relief is obtained in a few days the patient dies. [illegible] the acute cases are those resulting from strangulation, such as [illegible] volvulus, intussusception, embolism and thrombosis of [illegible] paralysis of the bowels from peritonitis, internal [illegible] and kinking of the bowel from adhesions and

In the chronic cases the symptoms come on gradually. There is an increasing difficulty in getting the bowels to act, with increased peristalsis, colicky pains and occasional attacks of diarrhea. Not infrequently, engrafted upon the chronic course of the disease, there occur attacks indicative of acute obstruction of the bowels, which condition may last for a few hours or a day, and then disappear. As the disease progresses the abdomen becomes tympanitic, and finally complete obstruction may occur. This class usually includes those cases in which the obstruction is due to impaction of gall-stones, feces, foreign bodies and the growth of tumors within the intestinal wall. The pressure of the tumor from without may also cause chronic obstruction.

SYMPTOMS.—In acute intestinal obstructions the symptoms are the same as those of strangulated hernia. The process comes on suddenly, with agonizing pain located at the seat of the obstruction, with nausea, vomiting and pronounced shock. The pulse is weak and thready, the face pinched, and the surface of the body bathed with a cold perspiration. The temperature is usually subnormal. The vomiting is progressive; at first the contents of the stomach, then green, bilious material, and finally stercoraceous matter are ejected. Constipation is usually absolute, not even gas being expelled. In cases in which the obstruction is situated in the small intestine, the contents of the large bowel may be expelled, giving rise to the belief that the obstruction has been overcome. The pain is continuous, with periods of exacerbation. After the first or second day, the pain is less severe, and with the occurrence of gangrene it may almost entirely disappear. The abdomen becomes tympanitic, in consequence of the dilatation of the bowel above the seat of the obstruction and the accumulation of gas. If the process is not relieved the patient becomes exhausted in consequence of the severe pain, loss of sleep, inability to take food, and toxæmia, and usually succumbs in from five to six days.

Special Forms of Acute Obstruction. Strangulation by Meckel's Diverticulum, by Bands and Through Apertures.—Meckel's diverticulum, when present, is a frequent cause of strangulation. Its extremity if free may become attached to the peritoneal wall, to the bowel or mesentery, forming a band or loop over, under or through which a coil of intestine passes, is unable to return and becomes constricted. A cord or band is frequently formed following an attack of acute peritonitis, which may cause constriction of the bowel in the same manner. The tip of the appendix, or the fimbriated extremity of the Fallopian tube, may, as a result of inflammation, become attached to some one of the adjacent structures, forming a band beneath which a coil of intestine may be caught and strangulated.

The normal apertures in the abdominal wall, such as the inguinal and femoral canals, are frequent sites of acute obstruction. Slits, traumatic, operative or congenital, may occur in the mesentery or omentum and be the site of obstruction. A loop of small intestine may pass into the lesser omental sac, or into the fossa duodeno-jejunalis, and become obstructed.

VOLVULUS.

By this is meant the rotation of the bowel upon its mesentery to such a degree as to interrupt the fecal current and usually the blood supply. It

is the most frequent cause of acute obstruction in the large bowel. The process may also occur in the small intestine, one or two coils of intestine being twisted up like a skein of yarn. In the large bowel the process most frequently occurs in the sigmoid flexure or cæcum. The condition is predisposed to by a lengthening of the mesentery.

The process is most common in males past 40, and is usually preceded by chronic constipation. The symptoms come on suddenly but are not so violent as in obstruction of the small intestine. There is usually localized pain, tenderness, nausea and vomiting, and often an ill-defined tumor at the seat of the obstruction.

IMPACTION OF FOREIGN BODIES.

Obstruction from this cause usually occurs in the lower portion of the ileum and the foreign body may be a gall-stone, some foreign substance which has been swallowed, or an enterolith. A gall-stone of sufficient size to cause obstruction usually gains an entrance to the intestine by ulceration, the intestine first becoming attached to the gall-bladder by adhesive inflammation. The obstruction will ordinarily have been preceded by symptoms of cholelithiasis. Recently I removed a gall-stone as large as a hen's egg from the ileum.

The symptoms of obstruction by foreign bodies are usually only semi-acute, in consequence of the obstruction not being absolute.

ACUTE INTUSSUSCEPTION OR INVAGINATION.

In this form of obstruction one portion of the bowel is telescoped into another. The upper portion is always invaginated into the lower. The invaginated portion is known as the intussusceptum, while the outer portion is known as the intussuscipiens. If a transverse section is made through the invaginated section, it will reveal three peritoneal layers. The outer is known as the ensheathing layer, the inner the entering layer and the middle the returning layer. The entering portion of intestine drags upon its mesentery, which becomes severely constricted by the ensheathing layer, interfering with and often interrupting the circulation (Fig. 311).

It is generally held that intussusception is due to violent or irregular peristalsis, the dragging of polypoid tumors within the intestinal canal, and possibly to strains or blows upon the abdomen. Childhood is a predisposing cause, in that more than 50 per cent. of the cases occur in children under 10 years of age. It is held that one-third of all cases of intestinal obstruction, exclusive of hernia and congenital conditions, are due to invagination; while three-fourths of all cases of intestinal obstruction occurring in children, are held to be due to intussusception.

Invagination is most frequently met with in the ileo-cecal region.

In this form the ileum becomes invaginated into the cæcum, carrying with it the ileo-cecal valve, which represents the apex of the intussusceptum. A large part of the ileum may become thus invaginated—so much in fact that it may reach or even protrude from the anus.

The second form is the enteric in which the small intestine, usually the lower portion of the jejunum, becomes invaginated.

The third is the colic, in which some portion of the colon becomes invaginated into the distal portion. And the fourth, the ileo-colic, in which the ileum is invaginated through the ileo-cecal valve.

In some cases intussusception occurs during the death crisis, and in these the invagination may be from below upwards.

PATHOLOGY.—With the occurrence of invagination the intussusceptum becomes severely constricted by the intussuscipiens. The mesenteric vessels are dragged upon and the circulation interfered with or interrupted. The parts are highly congested and an inflammatory exudate occurs into and upon the walls of the bowel, increasing their thickness and binding them together. Consequent upon the stasis in the fecal current and injury to the intestinal walls, the pyogenic micro-organisms contained within the intes-

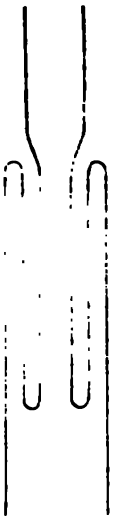


Fig. 311.—Scheme of invagination.

tinal canal may pass through its walls and cause a circumscribed or general peritonitis. In extra acute cases gangrene with perforation may occur. In some cases the obstruction is not complete and the symptoms are less severe.

The symptoms of intussusception differ somewhat from those of ordinary obstruction. The patient is usually a child: there is pain, which is quite severe and often occurs in paroxysms. Vomiting is present, but not severe; the pulse become quickened, but the temperature remains normal. A tumor, sausage-shaped and tender on palpation, can usually be felt, while there are frequent discharges of blood-stained mucus, or fecal matter, with marked tenesmus.

Occasionally the process is spontaneously corrected, or the intussusceptum may slough off, and be passed with the stool, the patient recovering. With very few exceptions, however, in acute cases, unless the process is artificially relieved, the patient dies in three or four days, from exhaustion and peritonitis.

CHRONIC INTUSSUSCEPTION.

This usually occurs in adults. The obstruction is usually not complete, and the symptoms are milder than in acute cases. There are colicky pains and at times vomiting and blood-stained stools. In some cases a tumor can be made out.

DIAGNOSIS OF INTESTINAL OBSTRUCTION.—Obstruction of the bowels is usually readily diagnosed, but it is often impossible to determine the cause without an exploratory incision. In acute cases the diagnosis will be determined by the sudden onset, the severe pain, shock, uncontrollable vomiting, absolute constipation and a normal or subnormal temperature. In endeavoring to ascertain the cause, the hernial rings should first be carefully examined and a history of the case obtained. In children suffering from intussusception a tumor can usually be felt. There is also tenesmus and frequent stools of blood-stained mucus. Volvulus usually occurs in patients past forty years of age who have suffered from obstinate constipation.

The symptoms are not as violent as in cases of strangulation and a tumor can at all times be made out. In obstruction by bands or adhesions there may be a history of previous peritonitis. In obstruction by gall stone there will be a history of cholelithiasis. If the obstruction is due to the pressure of an abdominal tumor, the growth can be made out by a physical examination of the abdomen. In congenital cases an examination of the anal region will often disclose an imperforate anus or rectum.

In adynamic obstruction, or that due to paralysis of the intestine from peritonitis, there will be fever and the symptoms of peritoneal inflammation. In obstruction of the bowel from Meckel's diverticulum or from thrombosis or embolism of the mesenteric vessels, a diagnosis as to cause is impossible without an exploratory incision. In chronic cases the presence of a tumor or the impaction of feces or foreign bodies may often be made out. Stricture of the rectum due to syphilitic stenosis or to the growth of a neoplasm can be readily determined by digital examination.

The symptoms depend in some slight measure upon the seat of the obstruction, in that the higher the obstruction or strangulation is situated, the more acute will be the process and the less urine will the patient void. If the process is situated high up, as for instance in the jejunum, the entire abdomen may be quite flat. If it is situated in the lower part of the ileum the central portion of the abdomen is likely to be tympanitic and distended; if it is situated in the sigmoid flexure, the entire abdomen, including the flanks and epigastric region, will be distended.

TREATMENT OF OBSTRUCTION.—The treatment will vary with the cause, but in all cases of acute obstruction the condition must be corrected without delay, if the patient's life is to be saved. The obstruction should be relieved if possible during the first twelve or twenty-four hours. In strangulated hernia the imprisoned loop of bowel must be relieved by taxis or by operation. In obstruction by bands, adhesions or Meckel's diverticulum, a laparotomy must be done and the bands resected or divided or the adhesions separated.

In volvulus, the abdomen is opened and the bowel untwisted, or an anastomosis made above and below the obstruction.

Foreign bodies are removed after opening the abdomen by an incision into the bowel.

In thrombosis or embolism of the mesenteric vessels the abdomen is opened and the affected portion of the bowel, if not too great in extent, resected and an end-to-end anastomosis made.

In intussusception the pain and excessive peristalsis should be relieved by opium, and an effort made, by distending the colon with air or water, to force back the invaginated portion of bowel to its normal position.

During the injection the patient should be partially suspended by the feet or have the pelvis elevated. Undue force must not be used for fear of rupturing the bowel. If the injections do not succeed a laparotomy must be done, when the condition can often be corrected by grasping the bowel on the distal side of the invagination and just below the apex of the intussusception and gradually forcing back the invaginated portion. Traction upon the proximal bowel is seldom of any value.

In chronic cases of obstruction due to impacted feces, high rectal injections of warm soap and water, or water and olive oil, will usually soften and bring away the impacted mass.

In obstruction due to the presence of a tumor within the walls of the bowel, the portion of the bowel implicated must be resected or the bowel short circuited, that is, an anastomosis made above and below the growth.

In cases due to syphilitic or cicatricial contraction, the portion of bowel affected should be resected, or an enteroplasty performed.

AFFECTIONS OF THE LIVER.

RUPTURE OF THE LIVER.

This may be the result of kicks, blows, crushing injuries, or penetrating wounds. The latter may include stabs and gunshot wounds. The symptoms of wounds of the liver are those of hemorrhage, shock, pain and local tenderness. These symptoms may be followed by fever and chills, indicative of pus formation, or by the symptoms of general peritonitis.

Diagnosis. The diagnosis, insofar as it is possible to establish it, will rest upon the history of the accident, the situation of the injury and the accompanying symptoms. In order to make a positive diagnosis an exploratory incision will usually be necessary.

Treatment. This may be symptomatic and antiseptic, unless there be indications of severe hæmorrhage or peritonitis. After exposing the liver hemorrhage may be controlled by gauze packing, or by the placing of deep quilted sutures through the substance of the organ. If there is any doubt about the absolute control of the hemorrhage, or infection, the abdominal cavity should be drained above the symphysis and the patient put to bed in a sitting posture.

ABSCESS OF THE LIVER.

This affection is of rare occurrence in this climate. It may be due to a variety of causes. A precedent dysentery is probably the most frequent cause. The micro-organisms in this case may be the amœba coli or the bacillus coli communis. It may follow operations for hæmorrhoids, suppurative affections of the rectum, lacerations or wounds of the liver, suppurative cholangitis, or pyæmia. There may be a single collection of pus or the foci may be multiple. They may be situated in any part of the liver.

SYMPTOMS.—There is fever, often chills, pain, localized tenderness and swelling. The liver is often markedly enlarged, and there may be bulging or even deep-seated fluctuation.

TREATMENT.—If the liver becomes adherent to the abdominal parietes and the abscess points in front or at the side, it may be readily cut into and drained. If on incising the abdominal wall there is an absence of adhesions, the area should be packed off with strips of gauze, the abscess located with an aspirating needle, opened and drained.

AFFECTIONS OF THE GALL BLADDER AND BILIARY PASSAGES.

RUPTURE OF THE GALL BLADDER.

This may be due to blows, crushing injuries, penetrating wounds or ulceration. The escape of bile into the general peritoneal cavity is likely to cause either a localized or general peritonitis. Normal bile is ordinarily aseptic, but the bile passages are very frequently infected, if only to a mild degree, while a large quantity of even normal bile, if escaping into the peritoneal cavity, is likely to cause peritonitis from irritation. If the rupture is due to a pathological process the bile is almost certainly infected and will cause peritonitis.

The symptoms of rupture of the gall bladder are shock, severe pain, at first localized tenderness, contraction of the overlying muscles, and the symptoms of peritonitis.

TREATMENT.—In rupture of the gall bladder the abdomen should be opened, the rent in the gall bladder either closed or provision made to drain the bile to the surface through a drainage tube by stitching the wound or rent to the abdominal wound, or by packing gauze about the gall bladder so as to lead the bile to the surface.

If the peritoneal cavity has been infected it should be cleansed, opened above the symphysis, washed out and drained.

CHOLELITHIASIS.

This is a term used to denote the presence of gall stones within the gall bladder or billiary passages. Gall stones while most frequently situated in the gall bladder, are often found in the cystic, less frequently in the common, and occasionally in the biliary ducts. They consist in the main of cholesterin and mucus, colored with bile pigment. They may consist in part or wholly of bilirubin calcium, of biliverdin calcium and carbonate

[illegible] in size and may be not larger [illegible] egg. In number there may be [illegible] present. When two or more are in [illegible] where they come in con- [illegible] that there are two or [illegible]

[illegible] been offered as to the cause [illegible] Bouchard is that the choles- [illegible] result of certain chemical changes. [illegible] ascribes the formation of gall [illegible] bladder or ducts.

[illegible] due to a catarrhal condition [illegible] which mucus is formed and [illegible] the result of bacterial in- [illegible] gall stones or other substances, [illegible] the chronic catarrh. If [illegible] washes out the micro- [illegible]

[illegible] of the cases of gall [illegible] typical symptoms of gall [illegible] jaundice. There [illegible] are absolutely without [illegible] It is not reason- [illegible] be present in every [illegible] These symptoms, how- [illegible] considered indicative of [illegible] heaviness and distress [illegible] and a burning pain with [illegible] is empty. There is often [illegible] pressure in the region [illegible] occasionally be palpated as a [illegible] mass projecting beneath [illegible] is round, always dull upon [illegible] with each inspiration and [illegible] distance. There may [illegible] months or years, im- [illegible] typical of gall stones make [illegible] per cent. of cases of chole- [illegible] and give no more marked [illegible] They may, however, [illegible] vigorous contractions of [illegible] by the stones, or in con- [illegible] to the presence of gall [illegible] stones entering the bile cur- [illegible] gall bladder or into the [illegible]

[illegible] duct are severe colic, [illegible] stances, jaundice. The [illegible] mittent or remittent, spas-

modic pain, and occurs when a foreign body is passing through a canal the lumen of which is much less than the diameter of the foreign body.

Hepatic colic is practically pathognomonic of gall stones, as it does not occur from occlusion of the ducts by pathological conditions occurring outside of the ducts or gall bladder. Clumps of inspissated bile, desquamated epithelium, or masses of mucus, if of sufficient size to produce distention of the ducts in their passage, may cause colic.

The attacks of colic occur irregularly, perhaps every few days or few weeks, and are usually very severe, requiring morphine for their relief. During the attack, the right upper quadrant of the abdomen, especially that portion bordering on the costal arch, is very sensitive to pressure. Local sensitiveness is to be differentiated from colic, the latter being intermittent or remittent, while local sensitiveness or local pain is continuous and is increased by pressure over the region of the gall bladder or beneath the right costal arch. If the gall bladder is much inflamed the upper portion of the right rectus, with the external oblique and its underlying muscles, will be in a state of contraction or hardness. Nausea and vomiting are reflex symptoms. They are always present when the pains are severe.

Jaundice occurs in about twenty per cent. of the cases; it may be due to a stone in the lower portion of the cystic duct, causing pressure upon the common or hepatic duct; or to swelling of the mucous membrane, and retention of bile, incident to the passage of gall stones through the common duct. The rather prevalent idea that jaundice must have been present at some time during the course of gall stones and that it is necessary in order to establish the diagnosis, cannot be too strongly combated.

Gall Stones in the Common Duct.—A gall stone when passing through the common duct, if of considerable size, produces colic, nausea, vomiting, local sensitiveness and perhaps subsequent jaundice. The extent of the jaundice will depend upon the time the stone takes in passing through the duct and upon the amount of traumatism, inflicted. If the stone becomes arrested within the common duct, jaundice is likely to occur within a few hours. In these cases the colic will come and go for several hours, or for a day or two, and then subside. This relief is brought about by a dilatation of the duct through the arrest of the flow of bile behind the stone, in consequence of which the stone floats back into the dilated portion and the obstruction for the time being is relieved. This belief perhaps lasts for a few days, when the colic returns in consequence of the stone again becoming impacted. The jaundice then is increased while the stools are white or clay color. This is the ball valve action of Fenger. The process may occur again and again for months or years. After a time the recurring attacks of colic are less severe and the jaundice, while varying in intensity, remains permanent. In fact it often deepens as time progresses. The skin of the patient is at first of a deep yellow color, then it changes to a greenish hue, and subsequently takes on a dark tinge so that he looks almost like a mulatto. There is also loss of appetite, disagreeable taste in the mouth, and a furred tongue, with loss of strength and weight. The condition is one of cholæmia or toxæmia, in which the blood loses its plasticity and hæmorrhages frequently occur.

Gall stones are to be differentiated from a variety of pathologic processes. This differentiation, however, is not always easy or even possible. One of the processes most closely allied to and associated with cholelithiasis, is an infective cholecystitis or cholangitis. As has been already stated, gall stones are probably always preceded by catarrh of the gall bladder or its ducts, but this catarrh is of a mild character and usually associated with a low grade of infection. It has been shown by experiment that when attenuated cultures of the bacillus coli communis are injected into the gall bladder the precipitation of cholesterin and the formation of gall stones occur, but when virulent cultures of the same micro-organisms are injected, a severe inflammatory process is established without the formation of gall stones. As the indirect result of the traumatisms inflicted by the gall stones, or as the direct result of the entrance of micro-organisms through the common duct or through the circulation, an infective inflammation of the gall bladder or ducts may be produced. These cases may or may not be associated with gall stones, but they are to be differentiated from the simple gall stone cases by the symptoms, in that gall stones when active produce colic, nausea, vomiting, tenderness and perhaps jaundice, but primarily no fever, while in pronounced infective cases the process is ushered in with pain, which may be severe, but which has not the characteristics of colic, followed by recurrent chills, high temperature, and great tenderness over the affected region. The characteristics here are absence of colic, but the presence of chills, fever and local pain.

In gastric ulcers there is usually pain, occurring immediately after eating, in some circumscribed area of the stomach, with localized tenderness, vomiting and hemorrhage; while in duodenal ulcers the pain comes on about two hours after a meal. In duodenal ulcers there is hemorrhage into the intestine. In both instances there is localized tenderness, increased by pressure. Gastric ulcers are more frequent in anæmic women between twenty and thirty years of age, while duodenal ulcers occur most often in men between thirty and forty years of age.

Gall stones are also to be differentiated from cancer of the liver, gall bladder and gall ducts.

Cancer of the liver, gall bladder or common duct may be and often is associated with jaundice. The jaundice, however, is continuous, does not remit or intermit, and is not preceded by, or associated with, colic. Cancer in these situations usually occurs in people past middle life, and it may at times be outlined as a hard, irregular, elastic and not especially sensitive tumor. The patient not infrequently suffers from a mild degree of fever, ranging from 99° to 100° F. The age of the patient, the constant jaundice without previous colic, the tumor, and the slight fever will be sufficient, ordinarily, to differentiate the process from cholelithiasis.

Cholelithiasis must also be differentiated from appendicitis. The two conditions are occasionally associated. Roughly speaking, appendicitis occurs in the lower right quadrant of the abdomen, while cholelithiasis occurs in the upper right quadrant. In acute appendicitis there is fever, while in cholelithiasis, unless there is marked infection, fever is absent. In appendicitis colic is absent though severe pain may be present; in appendicitis the tissues over the right lower quadrant of the abdomen are in a state of

tension; while in cholelithiasis the muscles covering the upper right quadrant of the abdomen are tense. The pain in appendicitis is usually situated at or near the umbilicus, while the pain in cholelithiasis is in the epigastric region beneath or below the right costal arch or behind the right shoulder. In chronic appendicitis inadvertent walking over rough roads causes distress. The area of tenderness in appendicitis is over the appendix, while in cholelithiasis it is over the gall bladder. Appendicitis is usually aggravated by constipation, while in cholelithiasis there is often pain or distress after eating, or when the stomach is empty. In from twenty to forty per cent. of the cases of gall stones, jaundice will be present at some time during the course of the disease.

PROGNOSIS.—Gall stones situated in the common duct usually go on to a fatal termination in from six to nine months. In extra acute cases they have been known to cause death in three weeks. Active gall stones in the gall bladder or cystic duct are said to lead to a fatal termination if undisturbed, in from eighty to ninety per cent. of the cases.

Gall stones not only cause severe colic and traumatize the gall bladder and ducts, but they favor infection, with the occurrence of cholecystitis, cholangitis, and empyema of the gall bladder. A stone arrested in the ampulla of Vater may divert the bile into the duct of Wirsung and cause a pancreatitis. It is probably true that the majority of cases of pancreatitis and fat necrosis have this origin.

Gall stones are also as a rule the indirect cause of the numerous and strong adhesions found to and about the gall bladder, ducts and adjacent organs. These adhesions cause a dragging upon the stomach and pylorus, producing pain and occasionally, in consequence of the pressure upon the pylorus, lead to dilatation of the stomach. An infective inflammation of the gall bladder, cystic and common ducts, indirectly due to gall stones, may pass into the hepatic ducts and liver, producing a pericholangitis with the formation of multiple abscesses. Gall stones may indirectly lead to gangrene of the gall bladder, with rupture and general infection of the peritoneal cavity. A gall stone may ulcerate its way into the small intestine and produce obstruction of the bowels. Gall stones, in consequence of the irritation they produce in the gall bladder and ducts, cause cancer in four per cent. of all cases (Mayo).

TREATMENT OF CHOLELITHIASIS, CHOLANGITIS AND CHOLECYSTITIS.—Professor Hans Kehr, of Halberstadt, who has operated on over 800 cases of gall stones, believes that a second attack of gall stone colic is an indication for operation.

There are two conditions which should be met in an operation for gall stones. One of these is the removal of the stones, and the other is the drainage of the gall bladder and ducts.

The gall bladder may be conveniently exposed by an incision along the upper portion of the right border of the right rectus, or along the costal arch. The gall bladder is then freed from adhesions, if they are present, brought into the wound, and the area surrounding it packed off with gauze, for the purpose of keeping back the intestines, and protecting the peritoneal cavity from infection. The gall bladder may then be aspirated, or, if thought best, the patient is turned upon the right side and the gall bladder freely

opened. After incising the gall bladder, gall stones are often washed out by the bile, while others presenting themselves at the incision may be picked out with forceps. To remove from the cystic duct or gall bladder non-encysted stones which are not readily accessible, the left forefinger should be carried along the side of the gall bladder and cystic duct, and while curved in the form of a scythe, pressed firmly against the duct or gall bladder, and withdrawn, milking out any stones which may be present and which are not impacted. This process may be repeated again and again. Any stones which are impacted in the pelvis of the gall bladder or in the cystic duct, and which cannot be removed by the milking process, should be exposed by direct incision.

After the removal of all the stones the opening of the gall bladder is stitched to the abdominal wound and a drainage tube introduced; or the gall bladder may be left free, while the wound in it is snugly closed about a drainage tube by a purse-string suture. The gauze introduced for packing and protection is removed, while one or two narrow pieces may be introduced about the gall bladder to assist in drainage. The major portion of the wound may then be closed.

In exposing the common duct, the technic practised by Mayo Robson and Moynihan should be followed. A large sandbag is placed beneath the lumbar vertebræ and an incision made through the outer border of the right rectus, extending from near the costal arch downward for about six inches. As soon as the gall bladder presents itself it is seized and the liver turned partly out of the wound. This is accomplished by carrying the liver down beneath the costal arch and then rotating it upon itself upwards and partly out of the abdomen. This brings the duct near the surface. The intestines and duodenum are packed off, the region of the common duct exposed, the stone palpated, the duct incised and the stone removed. The duct may now be drained by sticking into it a rubber drainage tube or carrying down to it a strip of iodoform gauze, or the wound may be closed by cat-gut stitches.

After dealing with the common duct, the gall bladder is usually opened, any stones present removed, and the gall bladder drained.

Surgical opinion differs somewhat at the present time as to the best method of dealing with the gall bladder in cases of gall stones. Some hold that cholecystostomy, or incision into the gall bladder with drainage, will meet the indications in a great majority of cases, while others believe that cholecystectomy, or removal of the gall bladder, gives the best results.

Cholecystostomy, with drainage, is the simpler operation and the one that has the least mortality.

In cases of pathologic gall bladder, when it is inflamed, thickened, indurated or perhaps gangrenous and surrounded by adhesions, it is best to do the excision.

CATARRHAL CHOLECYSTITIS.

This may be acute or chronic. The acute form is usually secondary to a catarrhal inflammation of the stomach and duodenum and is associated with jaundice. It may be secondary to gall stones, cancer or inflammation of the liver. The chronic form is often associated with gall stones, and

less frequently with jaundice. In every case the gall bladder is tender and often enlarged. There may be slight fever.

TREATMENT.—The treatment should consist in administering a bland diet, keeping the bowels open, and encouraging the patient to drink considerable quantities of fluid, preferably water or milk. In either case, but especially in those which are chronic, if the symptoms do not yield to a correction of the diet and medical treatment, the gall bladder should be drained

SUPPURATIVE CHOLECYSTITIS OR EMPYEMA OF THE GALL BLADDER.

This is often due to gall stones plus infection. The micro-organism causing the infection may be the bacillus coli communis, the streptococcus the staphylococcus, or the typhoid bacillus. The gall bladder becomes greatly distended with pus and may even rupture. At times its walls become seriously involved in a phlegmonous or gangrenous inflammation, as the result of a high grade of infection.

SYMPTOMS.—There may or may not have been previous symptoms of cholelithiasis. With marked infection there will be high fever, chills, severe pain and tenderness over the gall bladder, which is enlarged, and tension of the upper portion of the right rectus muscle.

TREATMENT.—The treatment consists in early drainage of the gall bladder, with the removal of any gall stones present, or (and what is usually preferable) the removal of the gall bladder. (Cholecystectomy)

INFECTION OF THE BILE DUCTS.

(CHOLANGITIS.)

This process is of frequent occurrence, is usually secondary to cholelithiasis, and frequently complicates or succeeds an attack of typhoid fever In a case which came under observation, a common round worm was found in the common duct. In severe cases the process goes on to suppuration with decided enlargement of the liver and gall bladder. In these cases there usually is jaundice.

SYMPTOMS.—The symptoms of cholangitis are fever, frequent chills with pain in the region of the bile ducts and gall bladder, tenderness and tension of the upper portion of the right rectus muscle. Associated with these symptoms there may be enlargement of the liver and gall bladder.

TREATMENT.—In the medical treatment the patient should be encouraged to drink large quantities of water, for the purpose of flushing and washing out the gall bladder and ducts. At the same time the bowels should be kept thoroughly open with salines, and the patient put upon a light non-stimulating diet. If the symptoms are not relieved in a few days the gall bladder should be drained. In some cases it is necessary also to drain the common duct.

HERNIA.

By this is meant the protrusion of any viscus from its natural cavity through a normal or artificial opening in the parietes. This condition may affect not only the abdominal viscera, but also the contents of the cranial and thoracic cavities. By the term hernia, used without a qualifying adjective, is meant the protrusion of some viscus from the abdominal cavity

through the surrounding parietes. This protrusion is commonly known as a rupture.

Hernia most frequently occurs at those places where the abdominal parietes are weakened by the passage of such structures as the spermatic cord or the round ligament of the uterus, through the inguinal canal, or by the passage of the vessels and nerves beneath Poupart's ligament, (crural canal), or at the umbilicus. A hernia may also occur at the obturator foramen, sciatic notch, through the diaphragm, or at various other points.

ETIOLOGY.—Hernia is more frequent in males than in females.

The majority of cases occur in childhood or young adult life in consequence of the nonobliteration of the funicular process of peritoneum, which in the male accompanies the testicle in its descent into the scrotum; and in the female the nonobliteration of the process of peritoneum which accompanies the round ligament to the labia majora.

The umbilicus is not infrequently imperfectly developed, leading to hernia; or there may be faulty development along the linea alba, favoring the formation of a hernia. The diaphragm may also be congenitally deficient, and lead to a protrusion of some of the abdominal viscera. It is also held that there is an hereditary predisposition to hernia in about one-third of the cases.

Any condition which weakens the abdominal wall or increases intra-abdominal pressure is likely to cause a hernia. Violent exercise, the lifting of heavy weights, bronchitis, whooping cough, constipation and pregnancy, all increase markedly at times the intra-abdominal pressure, and exert great force upon the weak parts in the abdominal parietes.

ANATOMY.—A hernia consists of a sac and its contents. The sac is a pouch of peritoneum which has been pushed through one of the hernial canals, or it may be the process of peritoneum which descends with the testicle or round ligament and is not subsequently obliterated. This unobliterated process of peritoneum leading to hernia, occurs only in the inguinal canal. The former is known as an acquired inguinal hernia and the latter as a congenital inguinal hernia.

The sac consists of two portions, a neck and a fundus or body. The neck is the constricted portion which corresponds to the hernial canal. The large, expanded part of the sac is known as the body. The opening of the neck into the abdominal cavity is known as the mouth. The sac, as the result of pressure, irritation or inflammation, often becomes greatly changed in appearance. At first it is reducible with its contents, but it soon acquires adhesions to the surrounding structures, and becomes thickened as the result of an inflammatory exudate. The contents of the sac, especially if this is omentum, frequently becomes attached to the sac by adhesions. When the contents is made up entirely of bowel, it is known as an enterocele, and when it consists of omentum, it is known as an epiplocele; when both are present it is known as an entero-epiplocele. The cecum, appendix, ovary or bladder has occasionally been found in a hernial sac.

DIAGNOSIS.—This is made by considering the following points: There occurs in one of the hernial openings, or at the site of a previous incision, a round or pyriform swelling, which increases in size when the patient stands, and often disappears when he lies down. The swelling increases in

size, becomes tense and gives an impulse on coughing; and if composed of intestine is usually round, elastic, may be tympanitic and gives a gurgling sound when reduced. An epiplocele feels doughy, and somewhat irregular upon examination; it is dull upon percussion and gives but slight impulse on coughing. If the hernia disappears when the patient lies down it usually reappears when he stands, leans forward, coughs or strains. In many cases a hernia does not readily descend unless the patient coughs violently or strains severely.

SPECIAL FORMS OF HERNIA.

INGUINAL HERNIA.

In every one hundred cases of hernia eighty-four are said to be inguinal. By this term is meant a protrusion which occurs along the inguinal canal. If the protrusion does not extend beyond the external ring it is known as a bubonocele, or incomplete inguinal hernia. If it extends into the scrotum it is known as a complete or scrotal hernia.

There are two principal varieties of inguinal hernia, the oblique and the direct. In the oblique the intestine descends along the inguinal canal, entering at the internal ring and emerging at the external. The deep epigas-

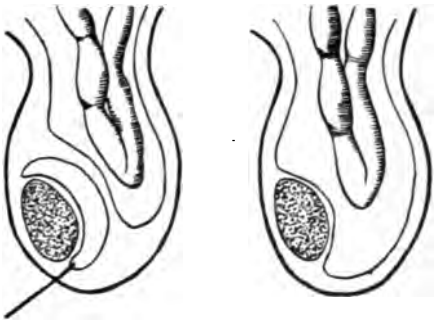


Fig. 312.—a. Acquired inguinal hernia. b. Congenital inguinal hernia.

tric artery is placed just internal to the sac. In old cases, in consequence of the dragging of the intestine or omentum, the internal ring is carried downward and made to approximate the external ring, when the inguinal canal is practically obliterated.

There are three varieties of oblique inguinal hernia, the acquired, the congenital and the infantile. In the acquired, the funicular process of peritoneum, which descends with the testicle into the scrotum, becomes obliterated at the internal ring and down to the tunica vaginalis. The intestine or omentum in protruding through the internal ring and inguinal canal, carries before it a pouch of peritoneum, which normally closes the internal ring. This covering or sac is increased in size by pressure and by dragging on the abdominal peritoneum (Fig. 312).

Congenital inguinal hernia is due to the nonclosure of the funicular process. This form of hernia may occur at any time during childhood, although it is rare after infancy. In this variety of hernia, the funicular process constitutes the sac (Fig. 312).

[illegible]

INFANTILE HERNIA.

In this variety the funicular process is shut off at the internal ring, bu remains open below and in communication with the tunica vaginalis. In thi form there is a distinct sac derived from the abdominal peritoneum whicl lies behind or invaginates the funicular process.

DIRECT INGUINAL HERNIA.

In this variety the protrusion is direct through the abdominal wall, t the external ring. It passes through what is known as Hesselbach's triangle which is bounded externally by the epigastric artery, internally by the oute border of the rectus muscle, and below by Poupart's ligament.

INTERSTITIAL HERNIA.

In consequence of some obstruction to the onward passage of the sa in the occurrence of an inguinal hernia, or as the result of unsuccessful ef forts at reduction, the sac is forced out of its natural channel and into th surrounding structures.

Three varieties of interstitial hernia are described: First, the extra peritoneal, in which the sac passes between the transversalis fascia and th peritoneum. It is difficult or impossible to recognize this form by examina tion, as there is an absence of external swelling. Second, the intraparietal where the sac makes its way between the internal and external obliqu muscles. Third, the extraparietal form, in which the intestine on escapin from the external ring, passes outward along Poupart's ligament (Fig. 313)

COVERINGS OF AN INGUINAL HERNIA.—From without inwards these are First, integument; second, superficial fascia; third, intercolumnar fascia fourth, cremaster muscle; fifth, transversalis fascia; sixth, subserous areola tissue; seventh, peritoneum (Fig. 314).

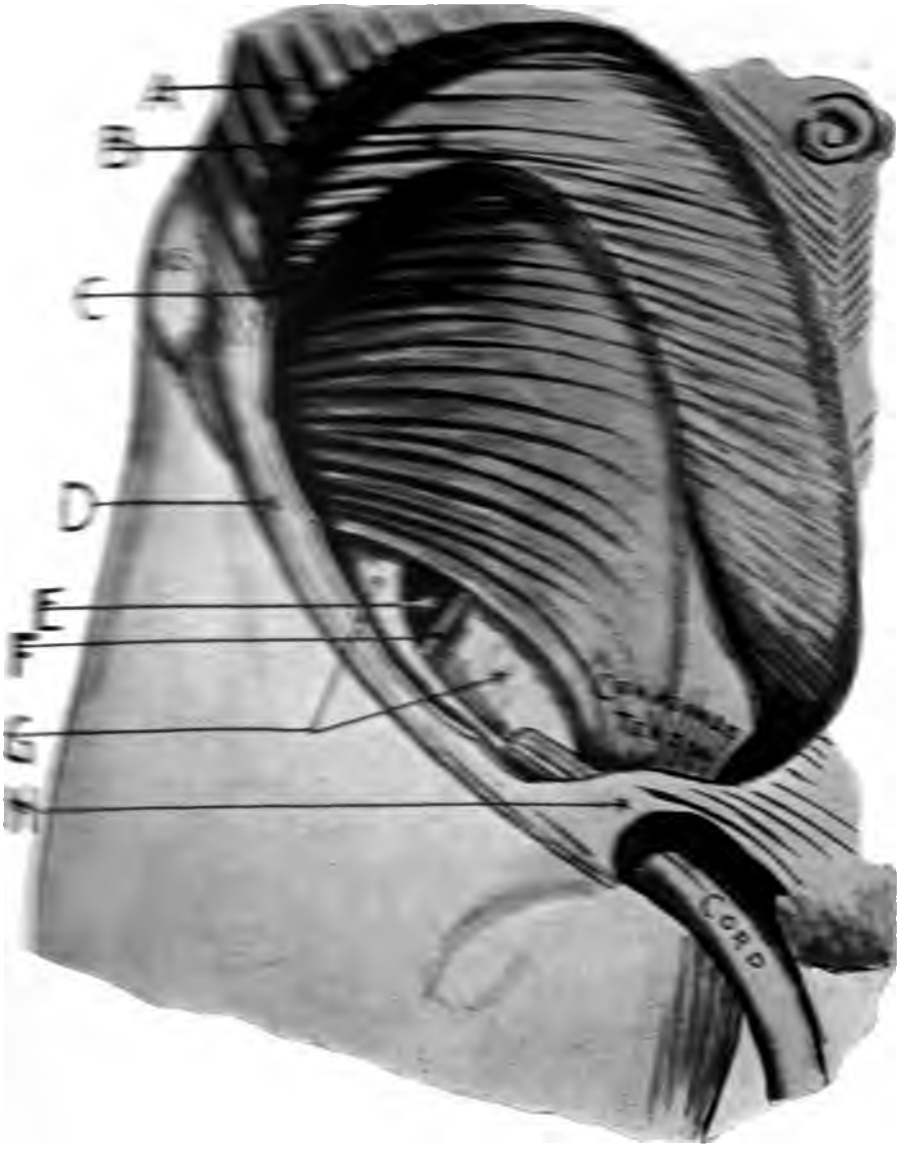
In congenital hernia the coverings are the same, except that the tunic vaginalis constitutes the hernial sac.

In infantile hernia the sac passes down behind funicular process. Con sequently, in operating, the two peritoneal coverings of the funicular pro cess must be divided before the hernial sac is reached.

In an operation for hernia it is difficult or impossible to differentiate al of these various coverings.

In direct inguinal hernia the protrusion is in Hesselbach's triangle, an if it occurs outside of the conjoined tendon the coverings are the same as i oblique inguinal hernia. If the protrusion carries the conjoined tendon be fore it, this structure will take the place of the cremaster muscle. In prac tically all cases of inguinal hernia, the cord invests the hernial sac upon th outside.

DIAGNOSIS OF INGUINAL HERNIA. One of the characteristic symptom is the appearance in the inguinal canal, or scrotal region, of a globular, elasti tumor, which shows when the patient stands up and disappears when h lies down. In hernia there is an impulse on coughing transmitted to th fingers placed over the sac. When the intestine is reduced it goes back wit a gurgling sound. In either intestinal or omental hernia a cord of consider able size can be felt filling the inguinal canal. In an irreducible hernia majority of these symptoms are present. A part of the tumor may be re



[illegible] Transversalis [illegible] Poupart's [illegible] Transversalis fas- [illegible]

guinal canal is empty. There is little or no impulse on coughing. An oper funicular process may fill with a serous fluid when the patient stands anc empty itself when he lies down. It fills, however, from below upwards fluctuates, and the inguinal canal is emptied.

Enlarged inguinal glands have frequently been mistaken for hernia but the glands do not change their position or form when the patient i recumbent, cannot be made to disappear, receive no impulse, and the hernia canal is empty.

A varix of the internal saphenous vein may be mistaken for hernia, i may practically disappear when the patient lies down, to recur when h stands. The varix, however, is nodular, bluish and associated usually wit varicosities in the saphenous vein, the inguinal canal is empty, and ther is an absence of impulse on coughing. Proximal pressure while the patien is lying down will cause a partial or complete reappearance of the varix.

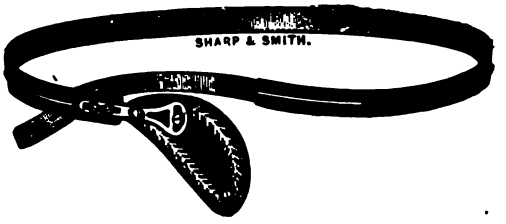


Fig. 315.

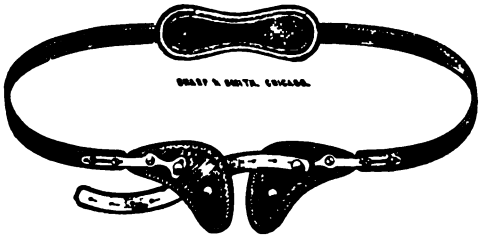


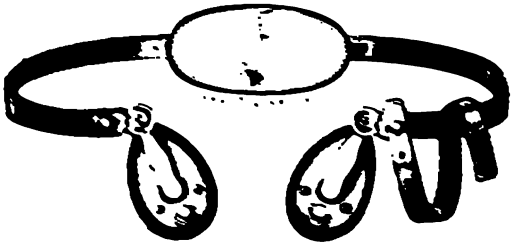
Fig. 316.

Varicocele has been mistaken for hernia; but here the inguinal cana is empty and there is absence of impulse. The varicocele also disappear largely when the patient lies down; but if the finger be placed firmly ove the external ring and the patient instructed to stand up the varicocele wil reappear, which is not the case with a hernia. This is also true of a varix A varicocele will present a "bag-of-worms" feel.

A retained testicle may also be mistaken for inguinal hernia, but if th scrotum is examined the absence of the testicle will be noticed.

Treatment of Inguinal Hernia.—This is palliative or radical. I the palliative treatment a truss is applied. In infants and young children cure is very often obtained by the wearing of a proper truss for from thre to six months. The truss causes a plastic exudate between the oppose serous surfaces and the neck of the sac, which joins them together, causin obliteration. In adults a cure can rarely be obtained by th wearing of a truss. A suitable truss must be selected for each in

vidual case, and by "suitable" is meant a truss that will under all condi-
ns whatsoever prevent the intestine from descending. If the hernial open-
gs are large, or the patient very stout, it will be difficult to retain the in-
stine by the application of a truss. The truss treatment should be recom-
ended for a period of six months in all cases of hernia occurring in in-
nts and young children. It also is to be recommended in persons over
xty years of age, in those who have incurable diseases, and in cases where
r some cause an operation is inadvisable. The measurements for a truss
ould be taken around the body, midway between the crests of the ilia and
e tops of the great trochanters. The pad of the truss is round or oblong
d can usually be set at almost any angle. The pad is made of wood, vul-
anite or hard rubber, highly polished, or is a leather or rubber sac stuffed
th air or fluid. The pad is placed over the hernial canal in oblique hernia,
over the external ring in direct hernia. The pad is held in position by a



[illegible] side, midway
[illegible] great trochanter. The
[illegible] of the covered
[illegible] to a stud on the
[illegible] of proper length
[illegible] spring it may
[illegible] be strengthened by
[illegible] be frequently bathed
[illegible] of chamois skin may
[illegible] The truss is ordinarily
[illegible] taken off after he lies
[illegible] truss has been worn for a few
[illegible] purpose of determining whether or not

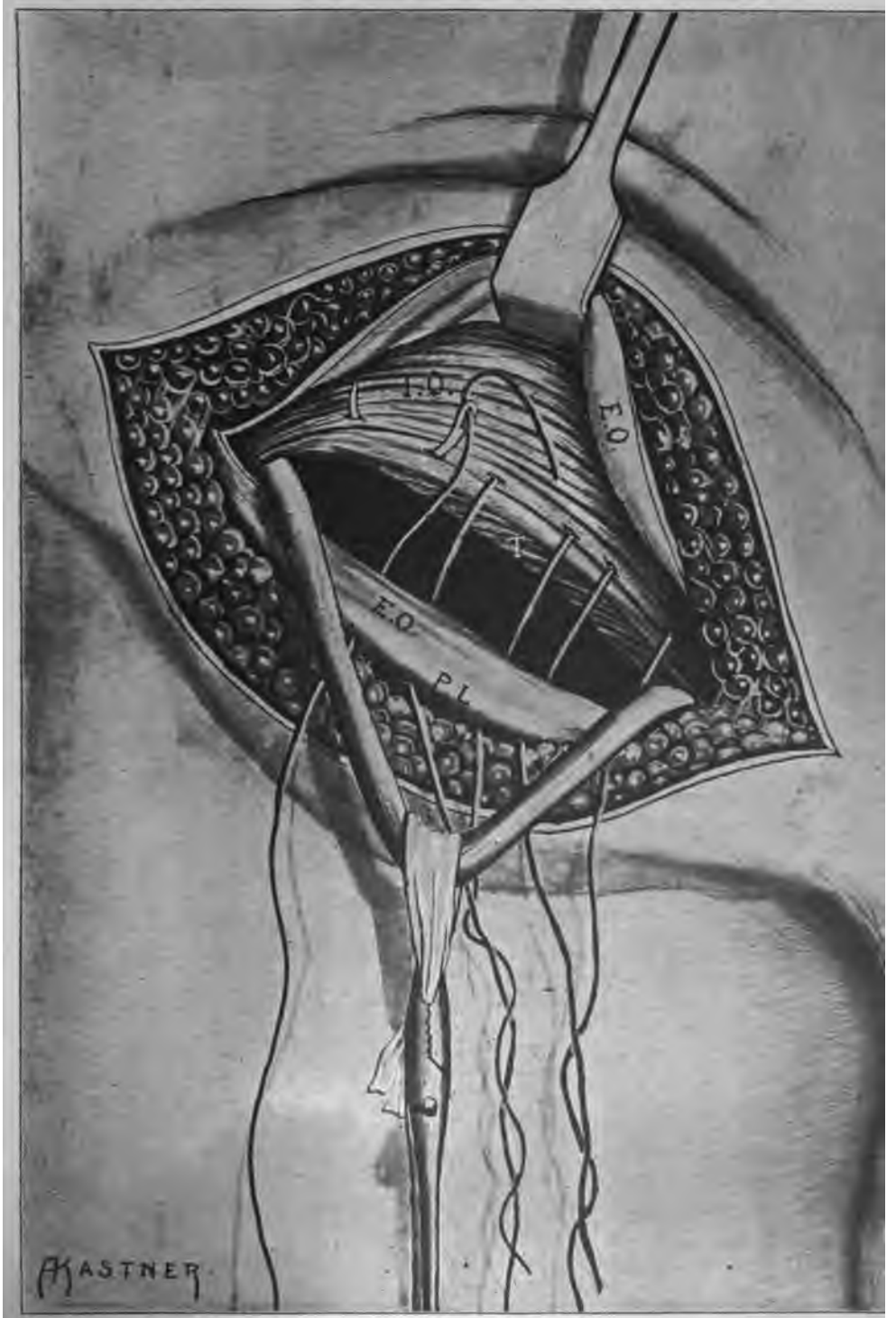


Fig. 319.—Method of introducing sutures through internal oblique and transversalis and the shelving portion of Poupart's ligament.

[illegible] has been effected. [illegible] trusses with soft leather pads; [illegible] trusses with enameled hard pad.

[illegible] —Operation [illegible] has been given [illegible] persons past sixty or sixty-[illegible] and pendulous abdominal [illegible] patients suffering from [illegible] disease.

[illegible] hernia and in hernias [illegible] The operative mortality for hernia, [illegible] a series of over 7,000 [illegible] The technic of the operation [illegible] The essentials for [illegible] freed from the surrounding structures [illegible] and the sac transfixed at the internal ring [illegible] Second, that the internal ring [illegible] requirements of the cord, and [illegible] buried sutures. [illegible] that primary union be obtained. [illegible] from ten to fourteen [illegible]

[illegible] —In this operation the sac is exposed, the external [illegible] the sac opened, its contents [illegible] ligated and removed. [illegible] arching fibres of the internal [illegible] the cord is then [illegible] Poupart's ligament [illegible]

[illegible] —In this operation the sac is exposed and separated [illegible] canal exposed by dividing [illegible] upwards and outwards for [illegible] external to the internal ring.

[illegible] an operation for [illegible] thoroughly opened, [illegible] prepared. The preparation [illegible] area, including the lower [illegible] soap and water. The [illegible] ride, when a moist [illegible]

[illegible] being anæsthetized, the [illegible]

[illegible] steps in the operation [illegible] over the internal ring and [illegible] to three inches. The [illegible] and external ring [illegible] forceps, the left forefinger [illegible] portion of the external [illegible] cord is then pulled up [illegible] the hernia is an irreducible [illegible] and small it will be seen

as a white membrane imbedded in areolar tissue on the internal surface o the cord. The sac is now exposed and freed from the surrounding struc tures up to the internal ring. If it is empty it is transfixed at this point an

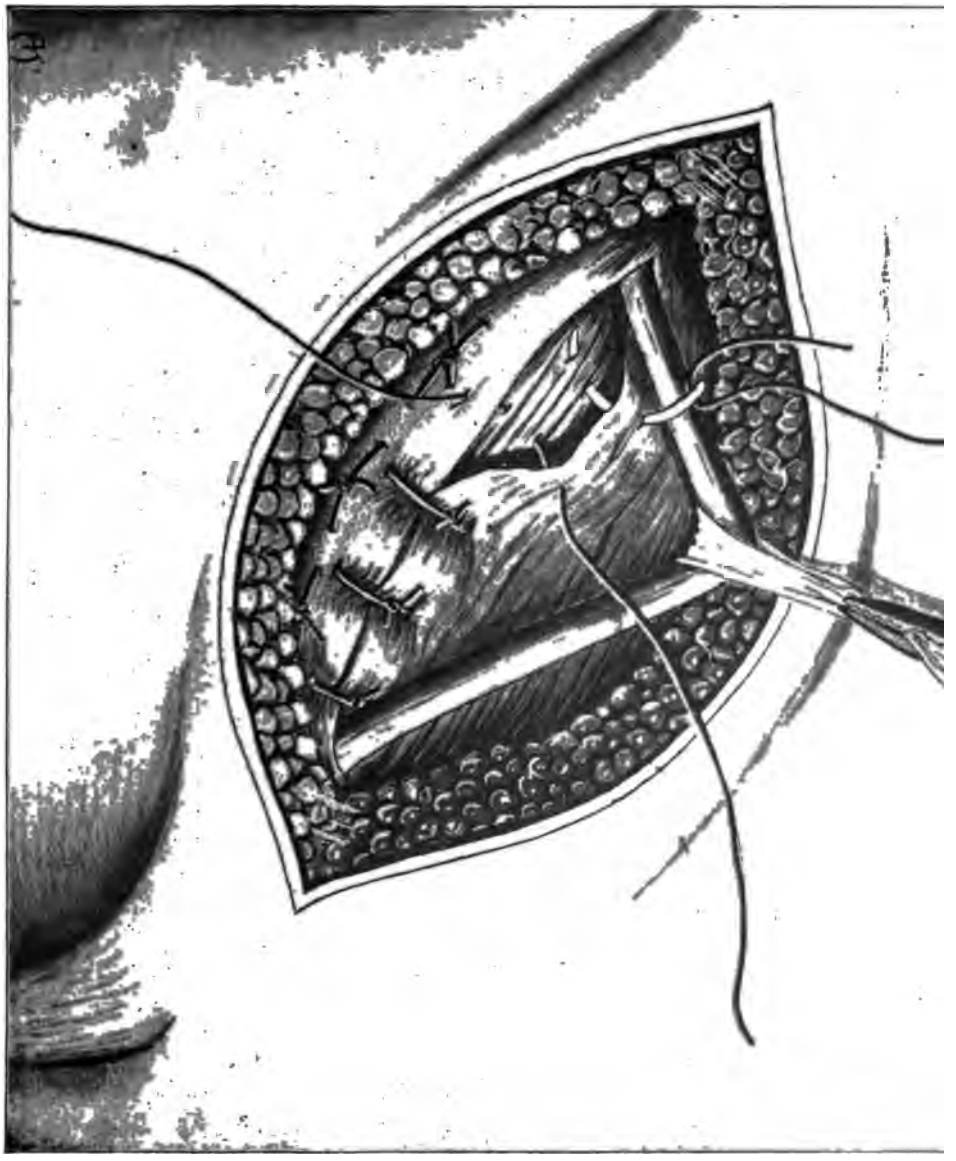


Fig. 130.—Suturing the external oblique to the [illegible]

then removed. If it contains intestine or adherent omentum, the latter con dition being frequent, the intestine is reduced, the adherent omentum tie off, divided distally, and reduced. The sac is then transfixed, ligated an

removed. The vessels which bleed are ligated with nonchromicised catgut, and the hemostatic forceps removed. The cord is freed, surrounded with a piece of gauze and held out of the wound. The external oblique is separated from the internal oblique and drawn upward with a retractor. Poupart's ligament is freely exposed and drawn upward with toothed or hemostatic forceps. The left forefinger with its palmar surface upwards is then inserted at the lower angle of the wound and pushed beneath the transversalis and internal oblique muscles. Commencing at the lower angle of the wound, a curved needle carrying a strong, chromicized catgut thread is passed through Poupart's ligament, one-eighth of an inch from its upper border, and then made to transfix a good portion of the arching border of the internal oblique and transversalis muscles, over the index fiuger. The needle is then carried backwards and made to transfix Poupart's ligament about one-eighth of an inch from the original point of insertion. The thread is drawn snugly and knotted. These sutures are placed about one-quarter of an inch apart, and are continued upwards until the internal ring is narrowed to the requirements of the cord. These sutures drag the internal oblique and transversalis over against the shelving portion of Poupart's ligament and completely obliterate the weak spot below the normal internal ring. The external oblique is then united to the top of Poupart's ligament with chromicized catgut sutures, the cord laid down, and the skin and superficial fascia united with interrupted silkworm gut sutures (Figs. 319 and 320). A large compress and suitable bandage are then applied. In cases in which the cremaster muscle is well developed, it may be united with catgut as the first step in the procedure.

With present methods of operating, recurrences are very rare.

FEMORAL HERNIA.

This is never congenital and rarely occurs before puberty. By femoral hernia is meant the condition in which the intestine or omentum passes out of the abdomen through the femoral or crural canal. The condition is most frequent in women, in consequence of the width of the pelvis and the greater space beneath Poupart's ligament. The femoral or crural canal constitutes the inner compartment of the femoral sheath, and is situated on the inside of the femoral vein and beneath Poupart's ligament. It is from one-quarter to one-half inch in length on its anterior surface and extends from Gimbernat's ligament above to the saphenous opening below. The femoral ring is the upper opening of the femoral canal, and has a transverse diameter of about half an inch. The opening is normally closed by the septum crurale. The lower opening is closed by the cribriform fascia (Fig. 321).

The intestine in passing through the femoral canal is situated beneath Poupart's ligament on the inside of the femoral vein and between the vein and the falciform process of Gimbernat's ligament. Posteriorly is the pubis.

Coverings of a Femoral Hernia.—From without there are found (1) integument, (2) superficial fascia, (3) cribriform fascia, (4) crural sheath, (5) septum crurale, (6) subserous areolar tissue, (7) peritoneum.

A femoral hernia does not so frequently contain omentum as does an inguinal hernia, but it is much more likely to become strangulated, in consequence of the unyielding nature of the surrounding parts.

-There is a round or oblong elastic
- face of the thigh, just below Poupart's
a coughing (Fig. 322). The swelling is
and often disappears when the patient lies

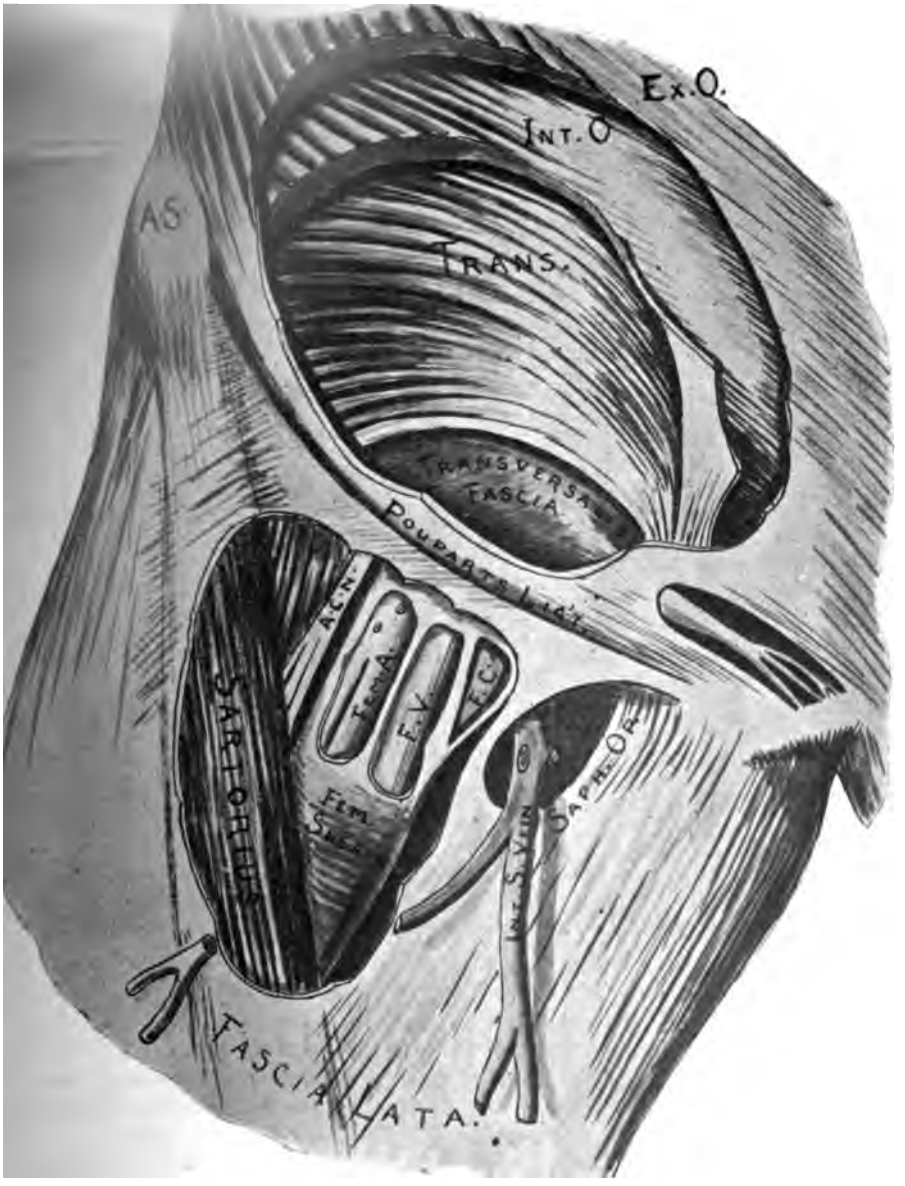


Fig. 321.—Showing anatomy of the femoral region

down. Femoral hernia is most frequent in women who are over twenty-five years of age.

DIAGNOSIS.—*Differentiation from Inguinal Hernia.* A hernia into the canal of Nuck occurs with especial frequency in young women. The important points of differentiation are that in inguinal hernia the tumor is above Poupart's ligament, is oblong, and its long axis lies in the direction of the ligament. Femoral hernia must occasionally be differentiated from a psoas abscess, which points beneath Poupart's ligament. In psoas abscess there will have been symptoms of spinal disease with loss of flexibility, while

Fig. 322.—Femoral hernia.

the protruding portion of the abscess will fluctuate and the patient will ordinarily suffer from slight fever. The process is to be differentiated also from varix of the internal saphenous vein, and from enlarged lymphatic glands and small fatty tumors.

The differential symptoms for these conditions are practically the same as those given under the head of inguinal hernia.

TREATMENT.—This is palliative or radical.

The palliative treatment consists in the application of a suitable truss. The pad is to be applied below Poupart's ligament and over the femoral canal.

Radical Treatment.—In consequence to the liability to strangulation and the further fact a cure is rarely attained by the wearing of the truss, operation should be recommended in all cases except where the patients are old or suffering from some incurable disease.

Technic of Operation.—The sac is exposed either by a perpendicular incision, or one carried along Poupart's ligament. It is then isolated, opened, its contents reduced, the sac transfixed at its neck, ligated and removed. The inner portion of Poupart's ligament is then firmly united to the pubic portion of the fascia lata and to the pectineus muscle by two or three quilted sutures of strong chromicized catgut.

In the Fabricius operation, which may be strongly recommended in femoral hernia, the falciform process is divided along Poupart's ligament, the vessels retracted outwards and the inner portion of Poupart's ligament firmly sutured to the origin of the pectineus muscle. These sutures should get a good hold of the fascia, muscle and periosteum.

HERNIA IN THE CANAL OF NUCK.

Processes of peritoneum in females descend before birth with the round ligament through the inguinal canal to the labia majora. These peritoneal processes frequently remain open and are often the site of hernias. They are frequently double, seldom become strangulated, occur in infants, young girls and young women, and usually before the twenty-fifth year of age.

A hernia into the canal of Nuck is to be differentiated from a femoral hernia by the fact that the former is often congenital, or occurs in children or young adults, is often double, seldom becomes strangulated and is situated in the inguinal canal and above Poupart's ligament.

TREATMENT.—The inguinal canal is laid open by an incision, the small sac isolated from the surrounding structures, ligated and removed. The parts are then united as in the operation for the radical cure of an inguinal hernia.

UMBILICAL HERNIA.

Three forms of umbilical hernia have been described: First, congenital umbilical hernia, in which there is failure of closure of the abdominal walls, with protrusion of the intestines or omentum into the cord.

In the treatment of cases which are not marked, after reduction, the cord should be ligated close to the abdominal wall, a small bit of gauze placed over the stump and the recti muscles drawn together by a long strip of adhesive plaster. Over this a compress and bandage should be applied. In severe cases where the opening is large, the sac may be opened after ligating the cord and the abdominal walls brought together by a few interrupted sutures.

Second, umbilical hernia of infants. This occurs usually some months after delivery and is due to the giving way of the cicatrix as the result of excessive crying, straining at stool, or while passing urine, in consequence of phimosis.

The treatment should consist in regulating the bowels, doing a circumcision if indicated, and drawing the abdominal walls together by a strip of adhesive plaster.

Operative measures in these cases are almost never indicated.

Third, umbilical hernia of adults. In these cases there is a protrusion of the intestine or omentum just above, below, or at the site of the umbilicus. The umbilicus is, however, practically always involved in the protrusion. The condition occurs with few exceptions in women who have borne children, and especially in those who are very fleshy. The sac in some cases reaches an enormous size, while the skin is often very much thinned and at times inflamed or ulcerated. The peritoneal sac is often very much thickened. The contents of the sac is usually made up of intestine and omentum. The hernia is ordinarily irreducible, in consequence of the adhesions between the omentum and sac, or between the coils of intestine. In these cases the recti muscles are forced wide apart and the abdominal wall is usually pendulous.

TREATMENT.—Palliative treatment consists in giving the sac and abdominal wall support by a well-fitting bandage.

The operative technique formulated by the Mayos, is excellent for this class of cases. The sac is surrounded by two curvilinear incisions with their long axis across the abdomen. These are deepened until the base of the sac is exposed. The sac is then opened, the attached omentum ligated and cut away, and the contents reduced. The opening is then closed transversely, first the peritoneum and then the fascia, which is made to overlap, and finally the superficial fascia and skin. The results by this method are most gratifying.

VENTRAL HERNIA.

By this term is meant a protrusion of intestine or omentum through the abdominal walls at some site other than at the hernial ring. Ventral hernia most frequently occurs at the site of a previous operation, in consequence of the giving way of the cicatrix. It is not unusual following the drainage of an appendiceal abscess.

TREATMENT.—If a compress and properly fitting abdominal binder do not give relief and the sac is increasing in size and causing discomfort, an operation should be undertaken.

In the operative treatment the sac should be dissected out and the wound united by interrupted tier sutures.

OBSTRUCTED HERNIA.

This condition occurs in consequence of the arrest of the fecal current in some portion of the intestine contained in the hernial sac. It may be due to the accumulation of hardened feces, undigested food, or to the arrest of foreign bodies in the bowel. The arrest of the fecal current, and the inspissation of the intestinal contents may follow adhesions, flexures or angulations of the bowel; and while most frequently found in the large bowel, may occur in the small intestine.

The symptoms are pain, increase in size and tension of the hernial swelling and vomiting, with constipation. The symptoms are compara-

tively mild, and are usually readily overcome by giving warm injections composed of soap and water, until the bowels have been thoroughly unloaded. Ordinarily from one to two quarts of water should be injected at each sitting, or as much as the patient can retain for a short period. If the hernial sac is not over-sensitive it may be gently manipulated to favor the onward movement of the intestinal contents.

STRANGULATED HERNIA.

By this is meant the constriction of the hernial contents, intestine or omentum, to such a degree as to arrest the circulation of the blood. While obstruction to the fecal current is usually complete it is not necessarily so, as in Littre's or Richter's hernia, where either a diverticulum or a portion of the bowel alone is strangulated, and in omental hernia, where only the omentum is implicated.

A strangulation at the abdominal rings occurs in one of two ways (a), either the hernia becomes strangulated at the point of its escape from the abdomen, in consequence of the intestine being protruded with force through one of the hernial rings, or (b), it occurs in old hernias in consequence of an additional knuckle of intestine, portion of omentum, or intestinal contents being impelled with great force into the hernial sac. In recent hernias the constriction occurs at the unyielding hernial ring—usually the internal. In old cases the neck of the sac, being thick and unyielding, is usually the site of the stricture.

Pathological Anatomy.—With strangulation of an intestinal coil the fecal current is first arrested, then the venous circulation and finally the arterial. With the arrest of the venous circulation the intestine becomes deeply congested, and of a dark-brown or black color. As the result of the obstructed circulation a serous exudate, often amounting to several ounces, usually occurs within the sac. The exudate is at first clear, but later, and especially if severe taxis is practised, or if the process is allowed to go many hours unrelieved, it becomes bloody. The intestinal coil, so long as its vitality is retained, remains smooth, has a glistening surface and is elastic. With the loss of vitality the peritoneal surface becomes rough, and its lustre and elasticity disappear. Grayish spots of necrosis or gangrene with perforation may occur. The mesenteric vessels may at times be felt as thickened, hard, thrombosed cords. In consequence of the strangulation, effects of taxis, lessened vitality or gangrene of the intestine, the micro-organisms and their ptomaines within the intestine may pass through its walls, infecting the serous or bloody exudate, and even the tissues outside of the sac. In these cases the contents of the sac is quite offensive. A strangulated piece of omentum may retain its vitality by forming adhesions to the sac. If gangrene supervenes the intestine becomes gray or brown in color and friable.

Symptoms of Strangulation.—These have already been given under the head of obstruction of the bowels, and are sudden, intense, often agonizing pain situated at the site of the stricture and from there extending over the abdomen. This pain is associated with shock, nausea, vomiting and obstinate constipation. At one of the hernial rings a tense, very painful tumor makes its appearance, coincident with the pain. Where strangula-

tion suddenly occurs the sac will at once become hard, tense, and the site of a severe pain. If the strangulation is not relieved the pulse becomes rapid and weak, the abdomen distended, the muscles tense, and the vomiting fecal. With the occurrence of gangrene the pain diminishes or disappears and the patient rapidly grows weaker and finally at the end of six or seven days dies from exhaustion in consequence of the inability to take food, the vomiting, the pain and loss of sleep, aided by the toxemia and possibly peritonitis (Fig. 323).

Strangulation in an epiplocele is rare, the symptoms less marked, often quite indefinite, and the prognosis less grave.

TREATMENT.—This consists in effecting reduction by taxis or by operation. By taxis is meant the manipulation of the tumor so as to effect, if possible, the relief of the strangulation and the replacement of the intestine within the abdominal cavity. In performing taxis the patient should lie upon his back, preferably upon a hard mattress, with the head supported by a pillow, the knees drawn up and the thigh on the affected side adducted. Sometimes it is desirable to elevate the pelvis. In perform-

Fig. 323.—A very large strangulated scrotal hernia

ing taxis the surgeon surrounds the tumor with the fingers and thumb of one hand and makes firm, continuous and steady pressure upon it for a few moments or until the fingers become tired. If not successful at the first attempt the taxis may be repeated, but it is seldom, almost never, advisable to repeat the process many times, or to continue taxis for more than ten or fifteen minutes. Severe force is never justifiable. The intent and purpose of taxis should be to so surround and compress the hernial tumor in the direction of the hernial canal, so as primarily to relieve the intestine of blood, and then of its contents, and finally to reduce the intestine itself. If the surgeon can succeed in relieving the intestine of its engorgement and then of something of its fluid contents, he will be successful in reducing the hernia. If the attempt is to be successful the surgeon will realize after a few moments of firm pressure that the tumor is diminishing slightly in size, and then suddenly a part of the liquid contents is forced back into the abdomen, and following a little more pressure the intestine returns with a gurgling noise. If the attempt is not successful and

there is a desire to avoid, if possible, an operation, the patient should be given a full dose of morphine hypodermically. If the symptoms are not especially acute he may be left for a few hours, when gentle taxis is again resorted to. I have known morphine to succeed after taxis has failed, in a goodly number of instances. Ordinarily if one does not readily succeed by taxis, an operation should be performed without delay. While the operation for the radical cure of hernia is almost without mortality, that for strangulated hernia has a mortality of from sixteen to twenty-five per cent. This high mortality is very largely due to the delay in operating, and to the use of unjustifiable force in taxis.

Operation.—The technique is very much the same as that for the radical cure of hernia. The sac is exposed by a proper incision and freed as far as the internal ring. The sac is then opened, the fluid allowed to drain off, and the sac and its contents cleansed with an antiseptic solution. Following this the intestine is carefully examined. If it is clearly visable the stricture is divided. This can usually be readily accomplished by inserting the tip of the left finger into the hernial ring, when a hernial knife is passed flatwise along the finger, until its tip passes through the ring, when the edge of the knife is turned against the stricture and the ring divided with a sawing motion. In some cases it may be convenient to pass a grooved director through the ring, in place of the finger, and upon this the knife is inserted and the stricture divided. In inguinal hernia the incision is made upwards for the purpose of avoiding wounding the deep epigastric artery. In femoral hernia, it is made inwards, the falciform process of Gimbernat's ligament being divided. After division of the stricture, the intestine is reduced and the wound closed as in any operation for the radical cure of hernia. Ordinarily if the strangulation has existed for several hours, it is best to drain the deeper parts of the wound by a wick of gauze, as infection is very frequently present at the time of operation. If the intestine is very dark, and there is a question as to its vitality, the stricture should be divided and hot compresses applied. If the color does not improve and the intestine becomes in a measure flaccid and loses something of its lustre, it should be resected. In doing this, the rings must be still further divided, and the constricted portion drawn well into the wound. The mesentery corresponding to the necrosed area is then ligated, the intestine clamped off on either side and the gangrenous area excised. The two ends may then be united by the use of the Murphy button or by silk sutures.

If after cleansing the sac and contents the intestine is found perforated or clearly gangrenous, one of two methods may be adopted. If the condition of the patient will not permit of a prolonged operation, or the surgeon has not the necessary materials at hand, the intestine is freely incised, the stricture, if necessary, dilated so as to afford good drainage, and an artificial anus established.

If a resection is determined upon the infected or perforated loop and sac must be carefully disinfected, the loop surrounded with gauze so as to protect the general peritoneal cavity, when the stricture is divided, the intestine drawn into the wound and the gangrenous portion resected.

INFLAMED HERNIA.

This is one in which the overlying structures are in a state of inflammation. The condition may be due to a variety of causes. The process may have its origin in a loop of intestine which has become infected, gangrenous or perforated. Infection may come from without or may be the indirect result of taxis.

TREATMENT.—If an inflamed hernia is strangulated, taxis is not permissible, but the surgeon should proceed at once to operation. An inflamed hernia which is not strangulated should be treated by the application of hot antiseptic compresses, or possibly by the application of ice. If pus forms the part should be freely incised.

IRREDUCIBLE HERNIA.

This is one in which the contents of the sac cannot be reduced except by operative measures. This is the result either of adhesions between the omentum and sac, or in consequence of adhesions between intestinal coils within the sac. In a strangulated, irreducible hernia, taxis is not permissible. The wearing of a truss is likewise interdicted in irreducible hernia, in consequence of the injury which may be inflicted by the pad. Irreducible hernia should be treated by operation, unless occurring in the aged or in patients suffering from incurable disease. No other treatment is permissible.

THE PERSISTENCE OF PAIN, VOMITING AND CONSTIPATION AFTER APPARENTLY SUCCESSFUL TAXIS.

The persistence of these symptoms may be due to a variety of complications: (a) The intestine may have been ruptured in consequence of undue force; (b) The intestine may be paralyzed as the result of strangulation or inflammation; (c) Gangrene may have occurred; (d) As the result of the application of great force to the tumor the hernia may have been reduced *en bloc*, that is, the intestine and sac are forced into the surrounding structures or into the abdomen. Again, as the result of the application of considerable force the intestine may be driven into a diverticulum of the sac, or the sac may be ruptured, and the intestine forced into tissues of the abdominal wall. In any case following the apparently successful reduction of a hernia, where the symptoms of strangulation continue, a most careful inquiry should be made into the cause, and this, if possible, corrected.

AFFECTIONS OF THE RECTUM AND ANUS.

For the purposes of examining the rectum, the patient should be placed on his side in the Sim's position, or upon his back with the knees drawn well up and the pelvis somewhat elevated, or he may be placed in the genupectoral position. It is essential in order to get a good view of the rectum that it be dilated with air. This is ordinarily readily accomplished by elevating the pelvis and opening the sphincter.

CONGENITAL MALFORMATIONS.

The human embryo has its origin from three separate and distinct germ layers, the external or epiblast, the internal or hypoblast and the mid-

dle or mesoblast. From the external layer is derived the skin, and the anus the latter comprising about one inch of the lower end of the intestinal canal. From the internal tube or hypoblast, comes the intestinal tract including the rectum. It is thus seen that the rectum and anus have their origin from different and distinct germ layers and have no connection primarily the one with the other, the anus coming from the outer germ layer or the one producing the skin, and the rectum, coming from the inner germ layer or that producing the intestinal canal. Up to the tenth week of intrauterine life the intestinal canal is practically a straight tube, and the lower portion or rectum ends in a blind pouch at some distance from the anus, but is directly connected in front with the urogenital canal. About the fourth

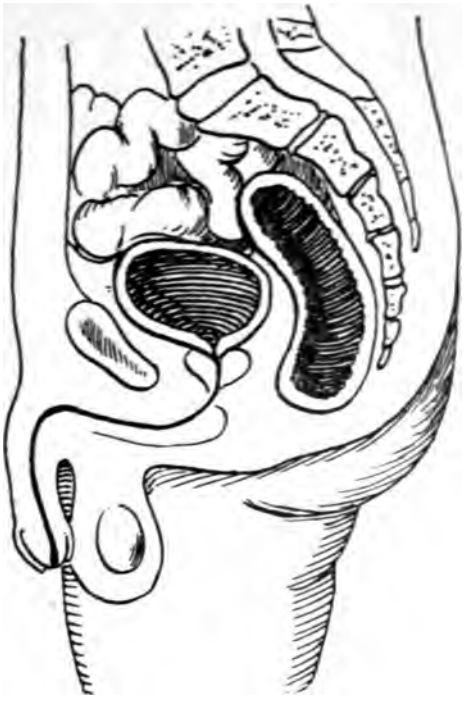


Fig. 324.—Imperforate anus.

week of intrauterine life, at the site of the future anus, a process of invagination of the skin takes place to the depth of an inch and a half, producing the anus. It, however, also ends as a blind pouch and is separated by a very considerable distance from the rectum. In the interval from the tenth week to the end of the fourth month of fetal life, if the development of the parts progresses in a normal manner, the rectum descends into the pelvis towards, and finally reaches and becomes attached to, the involute anus. The intervening membranes are absorbed and the continuity of the canal established. During this time a second and quite as important process is taking place, namely, the separation of the rectum from the bladder and genital tract, and the closure of the opening which has previously con

verted them into one continuous canal. If an arrest of development in these parts take place at any time before the fourth month of intrauterine life, one or more of several malformations may exist at birth, namely, should involution of the anus alone fail we would have what is known as imperforate anus, or *atresia ani* (Fig. 324), or if there has been simply an arrest in growth and descent of the rectum there would be an imperforate rectum, or *atresia recti* (Fig. 325). Both of these conditions may exist in the same patient, producing an imperforate rectum and anus (*atresia ani et recti*). (Fig. 326.)

An arrest of development may prevent the cutting off of the rectum from the bladder, occasioning a discharge of the contents of the bowel

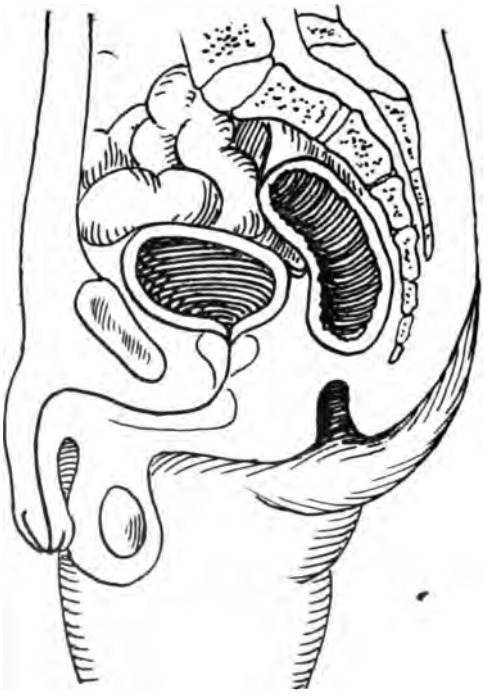


Fig. 325.—Imperforate rectum.

through the bladder and urethra (Fig. 327), or there may be in males a direct communication with the membranous portion of the urethra (Fig. 328), or a fistulous tract leading from the rectum to the perineum.

In the female, there may be a rectovaginal fistula (Fig. 329).

Diagnosis.—From the symptoms, aided by inspection and manual examination, it may be easy, difficult or impossible to make a positive diagnosis of the particular kind and extent of the malformation, and in at least a considerable proportion of the cases operative measures will have to be instituted, both for the purpose of establishing the diagnosis and correcting, if possible, the malformation. In imperforate anus, which is the simplest, and at the same time the most frequent of the malformations, inspec-

tion is sufficient for diagnostic purposes. Imperforate rectum may be a: sociated with a normal or imperforate anus. The anus being developed, digital examination will disclose the rectum either in apposition to the anu the continunity of the canal being interrupted by the unabsorbed walls c the anus and rectum, which lie in juxtaposition, or the examination ma reveal the fact that the rectum and anus are separated by a considerab interval, the bulging of the rectum being possibly felt when the child crie In these cases there is usually a fibrous or muscular band connecting tl parts. In other cases an examination may fail to disclose the position c the rectum, and one will be in doubt as to whether it is in the pelvis or no The anus being imperforate, the bulging of the imperforate rectum may i

Fig. 326.—Imperforate rectum and anus.

exceptional cases be felt through the skin, but more often it will be impo sible to determine its exact location by manual examination. Should tl rectum be in communication with the bladder, the meconium will be di charged *per urethram* with the urine; if the communication is with tl urethra, the meconium may be discharged quite separately from the urin In female children where there is an abnormal opening into the vagina, tl meconium is discharged per vaginam. In perineal fistulæ in connectic with an undeveloped rectum, inspection and an examination with a prol will be sufficient for the establishment of the diagnosis.

That each of these malformations, if not relieved, is most serious, apparent upon the most casual consideration, imperforation of the lowe

bowel being quickly followed by symptoms of obstruction, with colicky pains and vomiting, usually ending in death at the end of the fourth day, although there are a few cases that have survived for a longer period. When the rectum is in communication with the bladder a violent cystitis is soon established. If the opening is into the membranous portion of the urethra, symptoms of bowel obstruction may make their appearance and the condition end fatally. In imperforate rectum with perineal fistula, the same obstructive symptoms and unfortunate results may be expected. If the communication is with the vagina, the opening being sufficient, the child may not only live but thrive.

TREATMENT.—This may be so simple as to require but little more than a single incision, or so complicated as to necessitate either the most careful

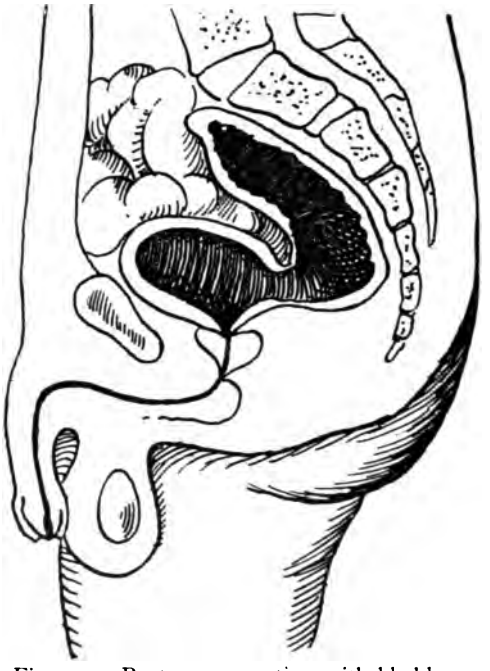


Fig. 327.—Rectum connecting with bladder.

and extensive dissection among important organs, or the opening of the abdomen and the formation of an artificial anus. There are cases in which the rectum and anus are perfectly formed, but the anus is closed by a thin epithelial layer, the pressure from within the bowel causing bulging and tension. This epithelial layer should be incised, or broken through with finger or sound, and then excised. When the anus is imperforate, the rectum being normally developed, an incision should be made commencing at the normal site of the anus and extending upwards and backwards for about one and one-half inches. The incision is deepened until the rectum is reached, which should be separated from the adjacent structures, brought down and secured in the wound by two strong stitches. The rectum is

then incised, the meconium allowed to flow out, and the bowel thoroughly washed out with an antiseptic solution. The rectum is then carefully united to the skin by an interrupted row of sutures. In imperforate rectum the operation is more difficult and serious, as not infrequently the rectum is placed high in the pelvis, with its lower and anterior surfaces covered by peritoneum, or it may in exceptional cases be situated in the abdominal cavity.

An incision for the relief of imperforate rectum should be made from the anus, if one is present, or from its normal site, back to the tip of the coccyx, or extended to its base, the coccyx being turned backward as on a hinge; or a portion of the sacrum may be turned up as a flap. By means of

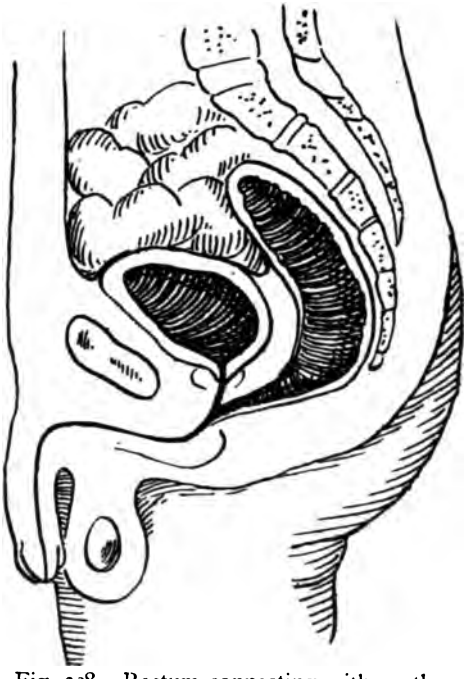


Fig. 328.—Rectum connecting with urethra.

the first, or the extended, incision, one will as a rule gain ready access to the rectum, even if it is placed high in the pelvis. In extending the dissection into the pelvis, it should be done with the finger and blunt instruments, and one should follow the course of the sacrum, as this will lessen the liability to injure the peritoneum. The rectum is recognized by its bulging when the child strains, and by its bluish color. When found it should be separated from adjacent structures, care being taken not to wound the peritoneum or bladder. If the anus is developed it should be denuded of its mucosa and then the rectum brought down and stitched into the anus. In other cases, the rectum is stitched to the skin. In either event after securing the rectum it is opened. If the coccyx or a portion of the sacrum has been turned up as a flap, it should be replaced and secured in

position by catgut stitches. If the rectum cannot be reached from below, the abdomen may be opened as for inguinal colostomy and the rectum sought for.

In those rare cases where the rectum is in connection with the bladder or urethra, it is approached as before through a peritoneal incision, separated with blunt instruments from adjacent structures, the fistulous tract cut through, and the rectum secured in the wound, the opening in the bladder or urethra being closed with carefully applied sutures.

In imperforate rectum communicating with the vagina the opening is usually just within the hymen. The operation may be deferred in these cases until the child is a few years old.

Fig. 329.—Rectum connecting with vagina.

The mortality in these operations is considerable. The child may die of shock, or hemorrhage, or of septic peritonitis in consequence of the peritoneal cavity having been inadvertently opened.

The ultimate success of the operation depends upon the after-treatment to prevent contraction, which must be guarded against for one or two years, after which the parts seemingly cease to contract. Dilation may be effected by passing through the anus and into the rectum, a large bougie, or the little finger. This should be practised for a time at least once a week.

INJURIES OF THE RECTUM.

These are occasionally due to falling on some pointed body, such as the handle of a fork, or upon a railing, or astride a chair. The foreign body may enter the rectum and do only slight injury to its mucous mem-

brane, or it may perforate the rectum and enter the abdominal cavity. If the injury is slight rest should be enjoined, the rectum washed out with a mild antiseptic solution, and a hot antiseptic compress applied. If the rectum has been perforated, careful provision should be made for drainage, the bowels moved regularly and the parts kept clean. If the abdominal cavity has been entered and the condition of the patient will permit, the abdomen should be opened, washed out, any injury that has been done to the abdominal viscera repaired, and the cavity drained.

FOREIGN BODIES.

Foreign bodies occasionally become lodged in the rectum. They may be derived from various sources. They have most frequently been introduced with food, or accidentally swallowed; or they may have been introduced directly into the rectum by the patient. They consist of fishbones, plates of teeth, pins or needles. A Murphy button or a gall stone may also become arrested in the rectum. The former body can often be removed by introducing the finger, which is hooked about the button when it is extracted. If the foreign body is not readily removed in this way, a Sim's speculum may be introduced, the sphincter dilated, the foreign body seized with forceps and extracted.

INFLAMMATION OF THE RECTUM. PROCTITIS.

This may be due to foreign bodies, worms, piles, or to infection. The symptoms are represented by pain, bearing-down, rectal tenesmus and frequent stools, which often contain large quantities of mucus, and at times traces of blood.

TREATMENT.—The treatment consists in removing the cause, keeping the patient quiet, restricting the diet, keeping the bowels thoroughly open, employing intestinal antiseptics, and frequently washing out the rectum and colon with a warm antiseptic solution.

THREADWORMS. (OXYURIS VERMICULARIS.)

These are worms about the size and length of a small pin. They frequently infest the rectum in childhood, and even in adult age. They give rise to severe itching, (*pruritus ani*), frequent stools which often contain mucus, and at times severe reflex nervous phenomena. The diagnosis is made by discovering the worms on the surface of the stools, or on the patient's person.

TREATMENT.—The bowels should be regulated and the rectum washed out each day, after the patient's bowels have moved, with a warm saturated solution of boric acid, or a pint of lime water, or salt water may be used.

RECTAL OR PERIRECTAL SUPPURATION.

The point of infection in these cases is usually from within the rectum. Predisposing causes may be a foreign body, ulceration or suppurating piles. Occasionally the infection is external and through an abscess of the glands of the skin.

These suppurative processes have been divided according to their situation into

First: Anal abscess (Fig. 330).

An anal abscess is situated at the border of the anus immediately beneath the skin. It may be the result of an injury or abrasion, followed by infection, or the result of infection of one of the sebaceous glands. The process occurs as a hard, round, inflamed and very painful swelling. It may open into the anus, leading to an anal fistula, or upon the surface, and heal spontaneously.

The proper treatment consists in early incision and drainage.

Second: Submucous abscess.

This may be the result of ulceration of the mucous membrane or an injury, or of suppurating piles. The process is not infrequently tubercular. The infection gets between the mucous membrane and the muscular coat of the bowel, and the pus may travel for some distance upward or downward and then rupture into the rectum, producing a blind internal fistula. On digital examination a hard, painful, indurated cord is to be felt directly beneath the mucous membrane.

In the treatment, if the abscess is discovered before it has opened, it should be freely incised and drained. If it has opened into the rectum the

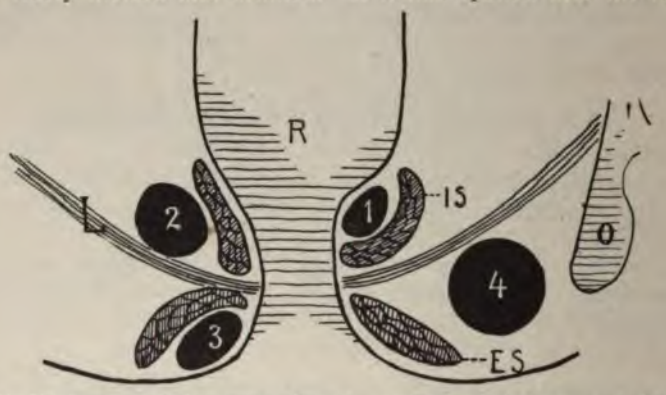


Fig. 330.—R. Rectum. 1. Submucous abscess. 2. Perirectal abscess. 3. Subcutaneous or anal abscess. 4. Ischiorectal abscess. E. S. External sphincter. I. S. Internal sphincter. L. Levator ani.

treatment will be that of blind internal fistula, subsequently to be considered.

Third: Acute ischiorectal abscess.

This is due to infection of the fatty tissue of the ischiorectal fossa. The infection usually has its origin from the bowel, although it may come from external sources. The process is ushered in with fever, perhaps a chill, followed by severe pain and swelling in the space at the side of the rectum. This area becomes infiltrated, hard, swollen and brawny. The skin is reddened and if the finger be introduced within the rectum a hard, very sensitive inflamed area may be distinctly mapped out.

If the abscess is allowed to take its course it is almost certain to rupture into the rectum, leaving a troublesome blind, internal, or complete fistula. The treatment should consist in an early and free incision into the ischiorectal fossa and abscess cavity, followed by drainage.

Fourth: Chronic ischiorectal abscess.

This is ordinarily due to tubercular infection. The patients are usually debilitated, anæmic, weak, thin in flesh, and are often suffering from tubercular infection in other parts of the body. The process comes on gradually with mild fever, deepseated pain, swelling and tenderness in the ischiorectal fossa.

The treatment should consist in early and free incision, so as to prevent the abscess opening into the bowel. After incision the cavity should be carefully curetted, washed out and lightly packed with iodoform gauze.

Fifth: Perirectal abscess.

This consists in a collection of pus between the wall of the rectum and the levator ani muscle. It may be secondary to penetrating wounds of the rectum, to ulcerative processes, to infection of the prostate, to pelvic cellulitis or carcinoma of the rectum.

The symptoms are those of a deepseated suppurative process and consist of fever, pain, deepseated swelling, difficult and painful defecation with a sense of heaviness and fullness of the rectum.

The diagnosis is established by making a rectal examination. The pus may pass through the levator ani muscle burrow about the rectum and reach the ischiorectal fossa.

The treatment should consist of early incision, which is usually placed behind the anus. Following the incision free drainage should be established.

FISTULA IN ANO.

This term is often incorrectly applied to suppurative tracts in or about the rectum. A fistula, as ordinarily understood, is a suppurating tract in which one end opens on the surface of the skin, or on a mucous membrane and the other in a hollow organ, or a tract which connects two hollow organs, as a recto-vaginal or a vesico-vaginal fistula.

A sinus is a blind, suppurating tract with but one opening, and that upon the surface of the skin or upon a mucous membrane. The causes of fistula or sinuses in this situation are abscess in the ischiorectal fossa, abscess about the anus, cancer, or stricture of the rectum with foci of infection above or below the stricture.

Fistulæ of the rectum are often of tubercular origin, and secondary to tubercular processes situated elsewhere in the body, and especially in the lungs. A complete fistula of the rectum or anus is one having an external opening upon the surface of the skin, an internal opening in the bowel, and a suppurating tract connecting the two openings. The external opening is usually situated in the perineum. It may be near the border of the anus. In these cases it often has its origin from an anal abscess, the internal opening being just within the anus and the tract external to the external sphincter.

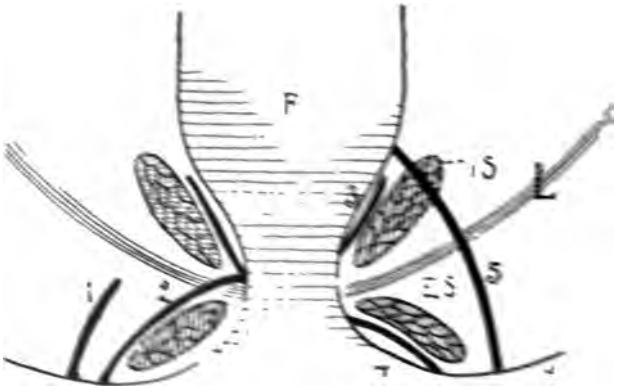
In fistulæ having their origin in an ischiorectal abscess, or following [illegible] stricture of the rectum, the external opening is usually situated farther [illegible] the rectum, it may be upon any portion of the perineum or upon the [illegible] while the internal opening is above the external sphincter, it may be [illegible] length from the anus (Fig. 331).

The tract of a fistula is often very circuitous. It may nearly encircle the bowel, while there are often two or more external openings. The pus in these cases has often undermined the skin and bowel in various directions. This is especially true of cases due to tubercular infection. In a considerable portion of the cases the infection is tubercular rather than pyogenic, or the infection is mixed.

In a blind external fistula, or, correctly speaking, sinus, there is an opening upon the surface of the skin and a suppurating tract which leads into an unhealed abscess. These sinuses may be at the border of the anus and not more than an inch in depth, or they may be situated at a distance from the anus and lead into the ischiorectal fossa.

A blind, internal fistula or sinus is one which has only an opening within the bowel, with a tract running beneath the mucous membrane. Such a tract may be short and quite straight, or it may be long and tortuous. The mucous membrane is often extensively undermined.

Diagnosis.—In complete fistula the patient's clothing is constantly soiled by the discharge of pus, fluid and particles of fecal matter from the



[illegible]

[illegible] the tract and through [illegible] the fistula opens [illegible] should be inserted into [illegible] quite prominent [illegible] This being found [illegible] passed along the tract [illegible] the probe [illegible] the skin can readily be [illegible] the fistulous tract is felt as a hard [illegible] fistula the probe cannot be made to pass [illegible] and performing the [illegible] the rectum is [illegible] the probe can usually be passed along the fistulous tract and can be felt by the finger in the rectum [illegible] the thin mucous membrane intervening. In cases where

there is doubt as to whether the fistula is complete or not, it is well to introduce a Sim's speculum into the rectum and then inject into the fistulous tract, with some force, dioxygen. This readily finds its way along the tract, and in complete fistula will be seen entering the rectum as a foaming mass.

TREATMENT.—Before operation the patient's bowels should be thoroughly unloaded. At the time of operation the external sphincter is dilated and the rectum washed out. In complete fistula a probe or grooved director is passed along the fistulous tract into the bowel and then made to emerge at the anus. The intervening tissue is then divided with a knife or Pacquelin cautery, liberating the probe. If there is more than one external opening these should be split up into the main channel. The tract is then carefully curetted and packed with a strip of iodoform gauze. The bowels should be moved on the second day, the tract washed out, and the packing renewed. This is repeated each day until the tract is healed.

In blind external fistulæ the probe is passed along the tract to the highest point of the fistula. It is then made to enter the rectum and protrude at the anus, and the intervening tissue divided. Subsequent treatment is as in complete fistula. In these cases the external sphincter is divided and the patient for a time at least loses control of the bowels when they are loose. But some of this loss is regained later in consequence of contraction of the cicatricial tissue.

In a blind, internal fistula the sphincter should be thoroughly dilated the internal opening of the fistula located, and a probe passed along this to its terminus. The overlying mucous membrane is then divided, any branching processes are slit open, the tract gently curetted and packed with a small strip of iodoform gauze. In these cases it is often advisable once in three or four days to stimulate the tract with a ten or twenty per cent solution of nitrate of silver.

FISSURE IN ANO.

This is usually a linear or more or less round ulcer, situated just within the anus and near the muco-cutaneous border. The fissure is within the grasp of the external sphincter, and is usually quite superficial, although recently I encountered one that was at least one-eighth of an inch in depth

Marked constipation with a passage of hardened feces over a delicate mucous membrane, is likely to occasion excessive dilatation of the anal region, and may readily cause fissure. Dysentery, eczema, the careless use of a syringe, the passage of foreign bodies, parturition and hemorrhoids are also causative factors. The condition usually occurs in adult life and is more frequent in women than is men.

SYMPTOMS.—There is an intense, often agonizing, pain during and following the act of defecation. The pain often continues for half an hour or more. The pain is frequently so severe that the patient refrains for days from having a movement of the bowels. If the passages are liquid less pain is experienced than when they are solid. A few drops of blood are at times to be seen upon the stool. There is often a great deal of flatulency, while a severe anal pruritus is at times present.

TREATMENT.—Palliative. This consists in getting a liquid evacuation of the bowels each day; in maintaining thorough cleanliness and in making topical applications to the fissure of a ten to twenty per cent. solution of silver nitrate. These applications may be repeated once in two or three days, while the ulcer is exposed by gently separating the folds of the anus and having the patient bear down. An ointment composed of a dram of ichthyol, ten grains of extract of opium and seven drams of vaseline, is also serviceable in soothing and favoring the healing of the fissure.

The curative treatment consists in thoroughly dilating the sphincter under an anæsthetic. The patient is anæsthetized, when the index fingers, after being smeared with vaseline, are introduced into the rectum and the sphincter forcibly and very widely dilated. The purpose of this is to paralyze the sphincter muscle and put the ulcer at rest, during which time it will heal. At the time of the dilatation the floor of the ulcer may be gently curetted or cauterized with a silver nitrate solution. Some surgeons prefer to freely incise the base of the ulcer or to incise the ulcer after having dilated the sphincter.

TUBERCULAR ULCERS OF THE RECTUM.

These are not common. When occuring they may be single or multiple and are not infrequently associated with fistula.

The symptoms are those of rectal irritability, pain and heat in the rectum, increased on defecation, with mucus, and at times blood in the stools.

The treatment consists in regulating the bowels and washing out the rectum, cauterizing the ulcer and packing into the rectum a bit of iodoform gauze. General treatment is also of decided importance.

FIBROUS STRICTURE OF THE RECTUM.

This occurs most frequently in women over 45 years of age, and is usually situated three or four inches from the anus. It may be due to a variety of causes, such as dysentery, or prolonged diarrhea followed by ulceration, tubercular or syphilitic processes; or it may follow an operation for piles.

SYMPTOMS.—At first there are usually alternating attacks of diarrhea with constipation. There is pain, often tenesmus, and a feeling of fullness in the rectum. At a later stage there are symptoms of obstruction with difficulty in getting the bowels to move. The stools are voided only after much straining, and are then thin or ribbon-like, and often mixed with mucus or even blood. The abdomen becomes distended. Fistulæ may form above the stricture, followed by suppuration, pain and fever. A rectal examination will disclose a hard, usually smooth, fibrous stricture, which may be annular or elongated. The latter is especially due to syphilis. In some cases the stricture is nodular, and ulcerated. If relief is not obtained the patient finally succumbs in consequence of exhaustion and septic poison.

TREATMENT.—In the early stages the bowels should be regulated and the passages kept fluid. When the contraction is pronounced the stricture, if within reach, should be dilated with bougies, with the finger, or with a dilator. Care must be exercised that a false passage be not caused by the

use of bougies. In obstinate cases the stricture may be freely incised p teriorly, or excised.

HEMORRHOIDS OR PILES.

Piles are the result of a dilatation of the veins in the lower inch of t anus, with or without a proliferation of the surrounding connective tiss

The causes of piles are various. The arrangement of the blood sup is probably a causative factor in that the veins in this situation have valves, represent the lowest part of the portal circulation, are but poo supported by the surrounding tissues, are subjected to great internal pr sure during straining, and represent one of the areas of communicati between the portal and systemic venous circulation. Piles are perhaps m frequently caused by long continued and obstinate constipation. Er position, sedentary habits, general debility, diarrhœa, and pregnancy, a prominent factors in the production of piles.

Piles may be considered under two headings, the *external* and the *ternal.* Frequently both forms are present in the same case. The exter pile is situated just beneath the skin and external to the sphincter musc There are often several of these surrounding the anus. They consist dilated varicose veins, branches of the external hemorrhoidal, which a surrounded by more or less new connective tissue and covered by the sk They appear as bluish, round, soft swellings, just at the border of the an and can be emptied by pressure. External piles do not bleed and usua give rise to no special symptoms, more than a pruritus ani, or a little d comfort, unless inflamed or thrombosed. If one or more external piles l come inflamed and thrombosed, there appears at the border of the anus round, tense, very sensitive, bluish-red tumor, which is the site of a ve severe pain. The cause of the inflammation and thrombosis may be inju extensive straining during defecation or infection. The patient is scarc able to be on his feet in consequence of the pain and general discomfort.

TREATMENT.—Rest should be insisted upon, the bowels thorougl opened, and a cold compress or ice bag applied to the inflamed region. cold is not agreeable, warm, moist, antiseptic compresses may be appli or an anodyne ointment may be smeared over the surface of the piles. the process does not readily yield to this treatment, the inflamed piles sho be freely incised, the bloodclot pressed out, when a bit of iodoform ga is introduced into the opening, and a compress and bandage applied. T patient can usually then, with some difficulty, go about his work. Follo ing the inflammation or incision of an external pile, a tag of skin is usua left at the border of the anus, and this tag may subsequently become flamed and cause considerable annoyance. If causing much distress should be cut away.

INTERNAL PILES.

Internal or bleeding piles are those situated upon the lower inch inch and a half of the rectum, within the external sphincter and beneath t mucous membrane. Each pile consists of dilated veins surrounded and h together by a quantity of connective tissue. They occur in two princi forms: (a) the long-columnar pile, which is often half an inch in wi and perhaps the same in height, and an inch or more in length. These pi

have a sessile base and three or four or even more may occur around the circumference of the rectum. And, (b) the globular pile, which is more or less soft and quite distinctly pedunculated.

The most pronounced symptoms are, (a) hemorrhage, which is usually but not invariably present, often profuse and which occurs with the stools; and (b) the protrusion of the piles with the movement of the bowels. If the piles are pedunculated and situated near the anus, they are likely to protrude with each movement. If columnar, situated high up and sessile, they are not likely to protrude. In addition to these symptoms there are some pain, fullness and discomfort in the rectum, associated with the desire to go to stool. Internal piles may become inflamed, the veins thrombosed, strangulated as the result of being protruded, or permanently prolapsed.

DIAGNOSIS.—They are ordinarily readily recognized by their situation, that is, external to the sphincter or occupying the first inch of the anus, by their bluish color, usually sessile base, by their bleeding and by the further fact that the piles are usually multiple. A polypus is single and usually markedly pedunculated. A cancer has a wide base, is indurated and infiltrates the walls of the bowel. Piles might be mistaken for prolapse of the rectum, but in piles there are distinct tumors which readily bleed, and which are easily differentiated from the normal mucous membrane.

GENERAL TREATMENT.—Venous congestion of the portal circulation, if present, should be relieved and the bowels regulated. Free and liquid evacuations each day are absolutely necessary. The general tone of the patient should be improved, and sedentary habits corrected. If the bowels protrude during defecation they should be cleansed, smeared with vaseline and reduced by gentle pressure.

In the local treatment of internal hemorrhoids, which are not causing great distress, some mild astringent may be used. Suppositories composed of the following, are serviceable:

℞	
Ferri subsulph. (Monsell's salt)	gr. 10.
Extract bellad.	gr. 3
Cocoa butter,	q s.

Mix, make 15 suppositories.

One of these suppositories may be inserted into the rectum each day after the bowels have moved, or an ointment containing adrenalin or the extract of hamamelis may be used.

SURGICAL TREATMENT.—In the surgical treatment of piles the bowels should first be thoroughly opened, the patient then anæsthetized, the sphincter widely dilated, and the rectum washed out. In the ligation method the individual piles are caught perpendicularly with a pair of long hemostatic forceps, near their base. That portion of the base which is bordered by the skin is then cut around with a pair of scissors, the pile transfixed with a needle and ligated with strong silk. The part which protrudes beyond the forceps is then cut away and the forceps removed. Each individual pile may be treated in this manner.

When the clamp and the cautery are used the piles are clamped at their base, the protruding portion cut away, and the clamped portion thoroughly cauterized with a Pacquelin cautery at a red heat.

After ligation or the cautery treatment, a large drainage tube cove with iodoform gauze which is smeared with vaseline, should be introdu into the rectum, both for the purpose of making pressure upon the pile a and preventing hemorrhage, and also for the escape of gas. The end the drainage tube is covered with a compress and retained in position b T-bandage. In these cases the bowels should be moved upon the third c following the administration of a saline cathartic, and the drainage t loosened by rotating it out of its position.

After the bowels have moved the rectum should be washed out an bit of iodoform gauze smeared with vaseline placed in the rectum. T may be repeated each day. The ligatures are allowed to come away of tl own accord. In many cases following the operation for hemorrhoids urine has to be drawn off for two or three days.

Whitehead's Operation.—In cases in which the lower inch of rectum is almost completely surrounded by piles, this inch of mucous m brane may be removed with great advantage, taking away all of the p according to the method of Whitehead.

An incision is made at the mucocutaneous border of the anus, and mucous membrane dissected up, carrying with it the piles. Great care m here be exercised not to go deep enough to do serious injury to the sphin muscle. As the membrane is dissected up it is drawn down by placing u it strong hemostatic forceps, until one comes to the upper limit of the pi when the pile area of the mucous membrane is cut away transversely. A bleeding vessels are ligated, and the incised border of the mucous membr brought down and united to the cutaneous incision by heavy quilted sutu placed about half an inch apart and around the circumference of the ar The mucocutaneous wound may then be more accurately united by a superficial sutures, when a drainage tube surrounded by iodoform ga and smeared with vaseline, is placed in the rectum as before.

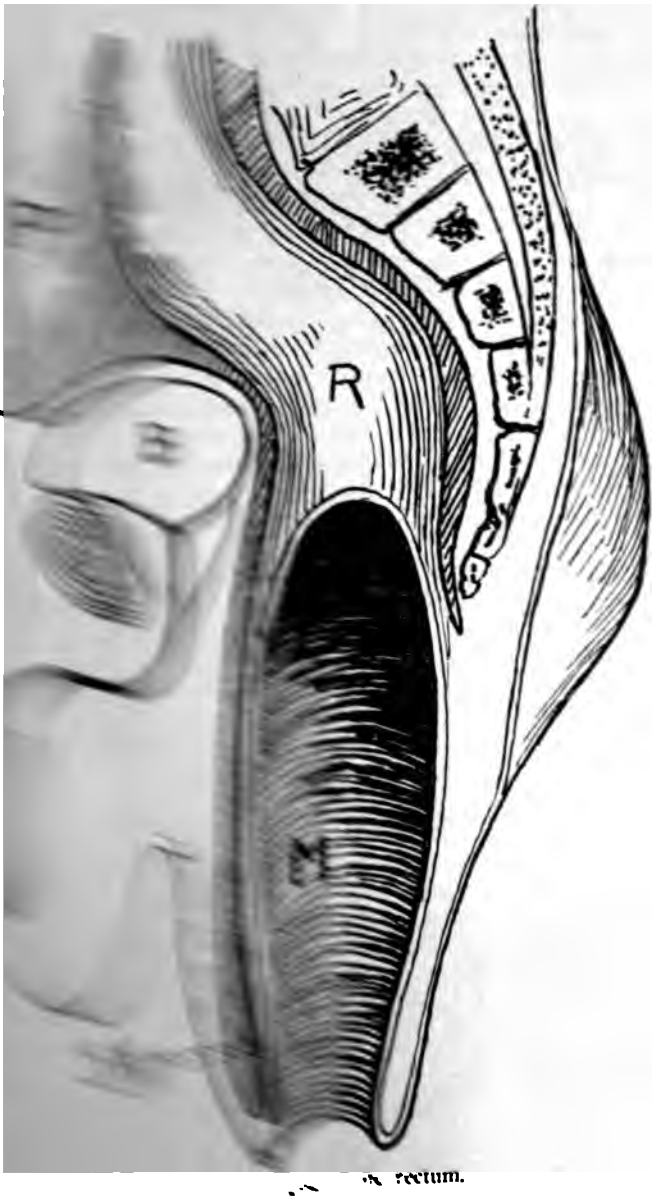
RECTAL PROLAPSE.

This affection has been divided into incomplete and complete prola In the former only the mucous membrane protrudes; in the latter all of coats of the bowel are implicated, usually including the peritoneal cover (Fig. 332). Incomplete prolapse is most often met with in adults, w complete prolapse occurs most frequently in children.

A lax condition of the tissues, with diarrhœa or constipation, strain at stool, and hemorrhoids are the most frequent causes. Any condit which is attended with straining, such as rectal tenesmus, tumors in rectum, stricture of the urethra, phimosis or vesical calculus is liable produce the condition. In aggravated cases the prolapse may occur e time the patient goes to stool, especially if the bowels are constipated the act is attended with straining.

Symptoms.—The anal region is occupied by a round, smooth swell which is covered by mucous membrane, through the center of which finger can be inserted in the rectum. The mucous membrane is continu on the outer side with the skin. At first the prolapse can readily be redu by elevating the hips and making a firm pressure upon it. If the mas allowed to remain unreduced it becomes decidedly congested, swollen, ble

[illegible]. In aggravated cases, and espe-
[illegible] the mass allowed to remain out for
[illegible] occur, followed by sloughing. There



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in children the prolapsed bowel should be at once reduced by inverting the child and making gentle pressure upon the mass with the fingers. After reduction a compress may be placed over the anus and the buttocks held together with adhesive plaster. The bowels should be moved, if necessary, by injections of cold soap and water, and during defecation the child should lie upon its back, while at the same time the anal region is supported by the fingers. When palliative measures fail, and especially in adults, operative treatment may be instituted. In mild cases the protruding mass may be cauterized in several longitudinal strips with a solid stick of nitrate of silver, nitric acid or the Pacquelin cautery. The bowel is then returned and a large drainage tube covered with iodoform gauze and smeared with vaseline, introduced. The bowels may be kept constipated for three days, then moved with injections of cold water while the patient is lying down. In more severe cases a V-shaped excision of the protruding mass may be removed, and the parts brought together by suture, or the entire mass may be excised and the upper end of the mucous membrane united to the skin. It is seldom necessary to remove all of the coats of the bowel. In some cases, however, of complete and aggravated prolapse it may be necessary to resect the entire mass. In these cases the peritoneal cavity will be opened in front and should be protected from infection by careful sponge packing. In cases which recur after operation it may be necessary to open the abdomen, drag the sigmoid upward and suture it to the abdominal wall.

PRURITUS ANI.

(OR INTENSE ITCHING AT THE ANUS.)

This is a most unpleasant affection. It usually occurs in young adults, and is most intense at night. The condition is due to a variety of causes, such as hemorrhoids, eczema, thread worms, proctitis, rheumatoid diathesis, or nervousness. The skin about the anus and between the buttocks, is usually moist and often of a dull white color.

TREATMENT.—The cause, if possible, should be ascertained and removed. This, however, is often impossible and the condition must then be treated symptomatically. The diet should be bland and non-stimulating, and the bowels kept open. Tonics are often advisable, and the salicylates may be used if there is a rheumatic tendency. The rectum may be washed out before going to bed, with tepid water, or boric acid solution, with advantage. Temporary relief is often obtained by applying a soothing ointment, such as the benzoated oxide of zinc ointment with 15 drops of glycerine and 8 of carbolic acid to the ounce.

CHAPTER XVII.

SURGICAL AFFECTIONS OF THE LYMPHATIC SYSTEM.

The lymphatic vessels invade practically every tissue and organ of the body, and in consequence of the delicacy and transparency of their walls they have been spoken of as the white vessels. Because of these characteristics and under ordinary circumstances they escape detection. The capillaries of origin have blind extremities in connective tissue spaces. Upon the surface of the body they reach, but do not invade, the epithelial layers and are composed of a single layer of endothelial cells placed upon a delicate connective tissue base, there being between the cells openings or stomata. The capillaries of origin form a close network of anastomosing vessels which later form collecting trunks which reach the lymphatic glands where they again break up into a capillary network. From the glands, larger and less numerous trunks carry the lymph to the right and left subclavian veins.

The lymph is a clear or slightly yellowish fluid, capable of coagulation.

The lymphatics are natural absorbents, and, excepting the capillaries, are composed of three coats like the veins.

The lymphatic system comprises the lymphatic vessels and glands and the lacteals, which do not differ from the lymphatic vessels except in their situation and in the further fact that they contain a milky fluid.

The lymphatics, in consequence of their property of absorption not only carry into the system many noxious substances, but become irritated and inflamed because of the presence of pathogenic organisms or their toxins.

ACUTE LYMPHANGITIS, OR INFLAMMATION OF THE LYMPH VESSELS.

This may be the result of septic or specific infection, chemical irritants, cold, heat, or injury. The process is most frequently caused by the absorption of septic material.

The intima becomes swollen, the endothelial cells proliferate and are cast off, and the walls of the vessel are invaded by round cells. Thrombosis is not infrequent, with infection of the surrounding structures. In mild cases the process ends in resolution, while in those more severe pus is formed. In some cases the process becomes chronic with thickening of the coats of the vessel, and partial or complete obliteration of its lumen.

The clinical signs will depend on the extent and situation of the pro-

TUBULAR LYMPHANGITIS.

This form is due to inflammation of the larger ducts in consequenc the absorption of septic material from an adjacent wound. The proces manifested locally by the presence of red, rather hard, elevated and tender streaks running up the limb to the nearest glands. If the ves become thrombosed, or their lumina especially narrowed, obstructing lymphatic circulation, the area drained by these vessels will become swc and œdematous.

SUPERFICIAL LYMPHANGITIS.

In this process the fine network of capillaries situated in the coriu inflamed. The area of inflammation may be small or very large. part is red, elevated, hard, well-defined and very sensitive.

INFLAMMATION OF THE DEEP LYMPHATICS.

The trunks of these vessels are placed beneath the deep fascia follow the blood vessels. There are, however, many communications tween the superficial and deep lymphatics. In many cases of cellulitis phlegmonous inflammation the process unquestionably starts in, an propagated along, the deep lymphatics, the trunks of which become thr bosed and rupture with resulting infection of the adjacent tissue. In t cases the wound of origin is a deep-seated one. The superficial and lymphatics are often inflamed at the same time, causing redness of skin with inflammation and infiltration of the subcutaneous connec tissue, leading to great swelling and marked induration of the parts.

SYMPTOMS.—In acute lymphangitis due to septic infection, there usually high fever, possibly chills, severe burning or throbbing pain in part, swelling and redness with loss of appetite, constipation, freque inability to sleep, and occasionally delirium.

TREATMENT.—Primarily attention should be directed to the wo if one is present, which should be rendered as nearly as possible ase and then thoroughly drained. Locally either cold or warm antiseptic c presses may be applied to the inflamed area, while in superficial lymphan the part may be painted with iodin, or smeared with an ointment comp of ichthyol ʒj and vaseline ʒiij.

In cases in which the deeper lymphatics are involved, with supp tion, free incisions should be made for the purpose of liberating the and thorough drainage established.

CHRONIC LYMPHANGITIS.

This process is usually the sequence of one or more acute attacks. may result from syphilitic, tubercular, or carcinomatous infection.

SYMPTOMS AND COURSE.—There may be slight pain and discom in the part affected. The skin is ordinarily not reddened but at ti unusually white; it is hard, œdematous, swollen and often the site o eczematous eruption. The vitality of the part affected is much reduce consequence of the obstruction of the lymphatic, and to some extent venous, circulation. Ulcerations are frequent.

TREATMENT.—In cases due to pyogenic infection, as in those which follow infection from a varicose ulcer, the port of entrance should be kept as nearly aseptic as possible.

Injections of a one-half per cent. solution of carbolic acid into the affected area, are often serviceable. Ichthyol or zinc ointment may usually be applied to advantage, while the part should be enveloped in gauze, absorbent cotton, and then supported by a snugly-fitting bandage.

INJURIES TO THE THORACIC DUCT.

These may be the result of severe contusion of the chest, punctured or gunshot wounds, of erosions from suppuration, or be due to accidental incision or rupture during an operation. According to the location of the injury the fluid may collect in the peritoneal cavity, behind the peritoneum, in the pleural cavity, in the posterior mediastinum, or in the wound.

The character of the injury is established by noting the characteristics of the fluid, which is opaque and milky. In a number of cases patients have recovered from an injury to the thoracic duct. In the neck the vessel has been secured by ligation or forceps and recovery has ensued. In less fortunate cases the patients die of inanition.

LYMPHANGIOMATA.

All intervascular clefts and meshes are lined with endothelial connective tissue cells and are in direct connection on the one hand with the lymphatic radicles, and on the other with the hemic capillaries. Consequently there is a most intimate relation between the two sets of vessels, as well as a close similarity in the neoplasms which they produce.

In comparison with angiomata lymphangiomata are rare. They occur as the result of the formation of new lymphatic vessels and lymphatic spaces in connection with the dilatation of those already existing. They may be congenital or acquired.

This genus is usually divided into three species, namely, first, capillary lymphangiomata, second, cavernous lymphangiomata; and, third, cystic lymphangiomata. The first two species correspond very closely both in their histology and anatomy with true angiomata, the only marked difference being that the vessels or spaces contain lymph in place of blood.

The first species, or the capillary lymphangioma, is usually congenital in origin.

It is quite true that it may not be observed for several weeks after birth but this is frequently on account of its diminutive size.

The growth may be made up of capillary lymphatics and be colorless, or it may contain a few hemic capillaries and present a more or less pinkish appearance. When [illegible] pure lymph, or a mixture of lymph and blood escapes.

These growths occur in the skin and mucous membrane in two forms, either as aggregations of capillary vessels producing a slight elevation of the affected surface above that of the surrounding skin or mucous membrane [illegible] vessels [illegible] studding the corium.

W[illegible] lymphangio[illegible] affect any [illegible] surfaces, they [illegible]ntly

situated on the inside of the thighs, over the lower surface of the abdomen, in the groin, or about the genitals. A flattened, slightly elevated, colorless, or slightly pinkish, lymphangioma situated on the surface of the skin may be small in size, not larger than a pin head, or two or more cm. in diameter.

MACROGLOSSIA.

In some cases the entire lymphatic system of the tongue or some portion thereof, becomes implicated, producing marked hypertrophy, the condition being known as macroglossia. This hypertrophy is largely confined to the mucous membrane, the growth is gradual, painless, or only gives a feeling of heat, tension and weight, and may become so excessive as to prevent the individual from retaining the tongue within the mouth (Fig. 333).

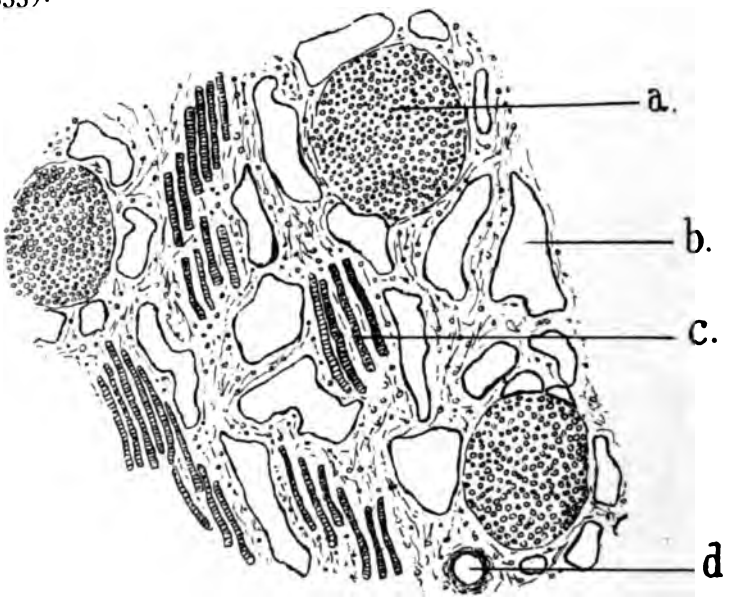


Fig. 333.—Lymph-angioma of the tongue. (After D. J. Hamilton.) a. Lymph-adenoid deposits. b. Lymphatic spaces. c. Muscle. d. Artery.

MACROCHEILIA.

In rare cases a portion of, or an entire lip may become greatly swollen in consequence of the implication of the lymphatic vessels, the condition being known as macrocheilia.

CAVERNOUS LYMPHANGIOMA.

This affection corresponds in its general characteristics to cavernous angioma, and may easily be mistaken for the latter infection. It is made up of dilated lymphatic vessels and connective tissue space, which communicate more or less intimately one with another. The spaces are lined with a single layer of endothelial cells, and between the spaces there is a greater or less quantity of connective tissue. There may also be some

adenoid, fatty or myxomatous tissue. The growth is made up largely of caverns, and contains either a clear lymph or a lymph more or less mixed with blood. Tumors may be formed which are large, lobulated, soft and fluctuating, and these may easily be mistaken, in consequence of their soft and lobulated character, for fatty tumors. They are found subcutaneously and are especially frequent in the neck and axilla, where they occasionally form tumors of very considerable size (Fig. 334).

CYSTIC LYMPHANGIOMA.

These growths are made up of cysts of greater or less size, and occur most frequently in the lateral regions of the neck and about the sacrum. They are occasionally large, dense, round, deeply-seated and distinctly fluctuating cysts, containing a clear fluid or one mixed with blood. They

Fig. 334.—A cavernous lymph-angioma of the forearm. l. Lymphatic spaces.

may be mistaken for branchial cysts, or those occurring from the breaking down of angiomata, for congenital cysts of the neck, or for dermoids.

Etiology.—A very considerable majority of the lymphangiomata are of congenital origin and result from some error of development. The close and intimate relationship between the capillary lymphatics and the capillary bloodvessels, and the similarity in histology between angiomata and lymphangiomata, lead us to believe that the causes of the two forms of growth are very similar. Many lymphangiomata are not congenital, making their appearance some weeks, or it may be years, after birth. In many instances, whether of congenital or of post-natal origin, the prime factors in their production are obstruction or increase of tension in the lymphatic circulation, or irritation of the lymphatic vessels.

)IAGNOSIS.—Capillary lymphangiomata when occurring on the internal ce of the thigh, over the lower abdomen, or about the genitals, appear as an aggregation of capillaries producing a thickening and eleva- of the skin, or as a cluster of distinct and separate vesicles. Either of if punctured, gives off a clear fluid, or one more or less mixed with (Fig. 335).

The large, cavernous lymphangiomata, in consequence of their size ystic condition, may require the use of a hypodermic needle to differ- e them from fatty tumors. The cystic lymphangiomata situated within eck will be difficult of differentiation from other cystic tumors, espe-

335. Capillary lymph-angioma from the peritoneum. (After Thoma.) l l l. Lymphatic vessels.

y those taking origin at the site of the branchial clefts, as well as those ch are dermoid in character, or congenital in origin.

TREATMENT.—The treatment of capillary and cavernous lympangio- a, when causing disturbance of function, presenting an unsightly appear- e, or where they are progressive in growth, should be that of excision en practicable.

In cases of macroglossia a V-shaped portion of the tongue may be ised, the wound being united with interrupted stitches. In cases of crocheilia the same method of treatment may be carried out.

ELEPHANTIASIS.

This is a chronic hypertrophy of the skin and subcutaneous tissue, due to obstruction of the lymphatic vessels. Elephantiasis may be divided into two principal varieties, elephantiasis Arabum, which is due to the development in the lymphatics of the filaria sanguinis hominis, and the non-filaria type, which is caused by a variety of conditions. The latter is frequently occasioned by chronic pyogenic infection, with inflammation and obstruction of the lymphatic vessels. It may also be due to tubercular or carcinomatous infection, or to operations in consequence of which the lymphatic current is arrested, as in operations in the axilla or groin.

Elephantiasis most frequently affects the extremities, face or scrotum. The affected part, in consequence of obstruction in the lymphatic circula-

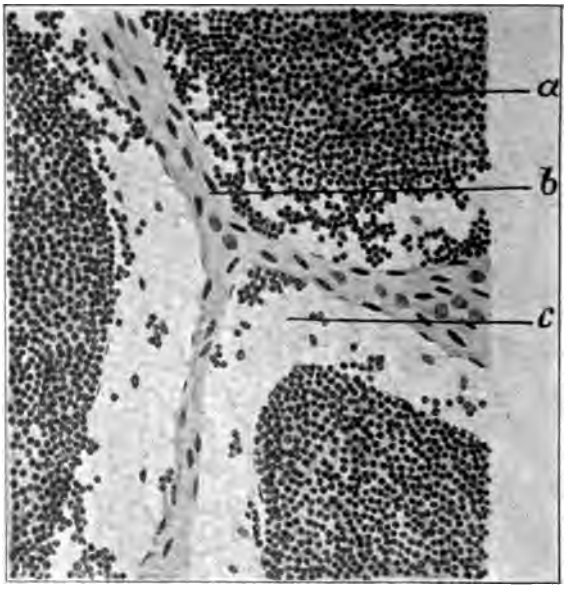


Fig. 330.—a. Lymph follicle made up of lymphocytes. b. Fibrous trabecula. c. Perifollicular lymph sinus showing fine reticulum.

tion, becomes hard, brawny and greatly swollen, with an overgrowth of subcutaneous connective tissue, and marked thickening of the skin. In long standing cases the surface of the skin becomes uneven, nodular, bossed, and the skin enormously thickened. The process is extremely chronic, usually runs its course without fever, and does not necessarily shorten the life of the individual.

Elephantiasis Arabum is seldom seen outside of the tropics. According to Manson the disease is spread through the agency of mosquitoes, in whose bodies the intermediate stage of the filaria is passed. The mosquito is supposed to take the filaria with the blood which it extracts from a case of elephantiasis. Following the intermediate stage the mosquito dies, the

ova are set free and are taken into the stomach of man with food or drink. Once in the stomach the parasite is set free, passes through the gastric or intestinal mucous membrane and becomes lodged in the lymphatics. But a few pairs of mature filariæ are present in any individual case. The female parasite is about three inches in length, and produces a great number of embryonic filariæ, which are about one-eighth of an inch in length, and are either coiled or uncoiled in the lymphatic vessels, where they produce obstruction of the circulation. They find their way into the blood stream at night (filaria nocturna) or by day (filaria diurna) and may be detected on microscopical examination.

TREATMENT.—In cases of non-parasitic elephantiasis, the cause, if possible, should be corrected, and the lymphatic circulation established and supported. As the most frequent cause is pyogenic infection, the wound or ulcer of entrance should be thoroughly cleansed, kept in an aseptic condition and perfectly drained. As already stated hypodermic injections of a carbolized solution are often serviceable in this class of cases. The unaffected part should also be well supported by a bandage. In aggravated cases, partial excision of the hypertrophied tissue may be practised, or even an amputation done. In elephantiasis Arabum in a few cases the parent filariæ have been located and excised. In some cases the dilated lymphatic vessels have been dissected free and implanted into the adjacent veins. In other cases excision or amputation has been done.

AFFECTIONS OF THE LYMPHATIC GLANDS.

ACUTE LYMPHADENITIS, OR INFLAMMATION OF A LYMPHATIC GLAND.

This process usually occurs from the absorption of septic or infectious material, which may come from suppurative or specific wounds, or from scarlatinal or diphtheritic inflammation (Fig. 336).

PATHOLOGY.—The gland becomes greatly swollen in consequence of the hyperemia, inflammatory exudate and cellular proliferation. If the process is due to pyogenic infection there are likely to be numerous foci of pus formation within the gland.

CLINICAL COURSE.—There is usually high fever, possibly chills, and pronounced indisposition. The affected glands become swollen, hard, tender and painful. The process often transgresses the gland capsule and causes a periadenitis with the formation of adhesions to adjacent structures. After a few days resolution may occur, or the process may go on to suppuration.

TREATMENT.—Primarily the treatment should be directed to the relief of the cause. Suppurating wounds should be cleansed and drained, and the bowels opened. Quinine may be administered for the fever. Locally, cold or warm antiseptic compresses should be applied. If pus formation occurs, free incision should be made and the foci drained.

CHRONIC SIMPLE LYMPHADENITIS.

This is due to some irritant which is not sufficient to cause suppuration. The process frequently occurs in eczema of the scalp and in nasopharyngeal catarrh, in so-called strumous individuals, and following strains,

injuries and colds. In this process some of the glands in the occipital, submavillary, cervical, axillary, or inguinal region are usually enlarged, palpable, and perhaps the size of a bean or hickory nut. They may remain for months in this condition. They are usually freely movable, not especially tender, quite hard and free from adhesions to, or redness of, the skin.

PATHOLOGY.—In these chronic cases there is primarily hyperemia with inflammatory exudate into the gland structure. The cells of the capsule and trabeculæ proliferate, and also to a less degree, the lymphoid cells. If the process is arrested after a short duration the hyperemia and inflammatory exudate disappear, and the new cell formation may undergo retrograde change and be absorbed. In cases in which the process is of long duration the new epitheloid cells become converted into connective tissue, with thickening of the capsule and trabeculæ and enlargement of the gland.

TREATMENT.—The source of irritation should, if possible, be relieved, the part kept at rest, and mild counter-irritants applied, such as iodin, mercurial or ichthyol ointment; and at the same time the general system should be supported and built up. Good and easily digested food should be administered and out-door exercise encouraged. Internal tonics may be given.

CHRONIC SYPHILITIC LYMPHADENITIS.

In hard chancre the inguinal glands become enlarged usually to about the size of a bean. The glands are smooth, quite freely movable and free from pain unless mixed infection has occurred. In the secondary stage the glands throughout the body are quite generally enlarged, but free from acute symptoms. In the tertiary period some of the glands may become enlarged in consequence of the gummatous formation. In these cases they may break down and suppurate.

CHRONIC TUBERCULAR LYMPHADENITIS.

[illegible] in children and young adults. [illegible] chronic inflammation of the [illegible] secondary to a tubercular [illegible] mediastinum, or in a chronic [illegible] infection may come [illegible] the skin or mucous mem- [illegible] and has suffered [illegible] surroundings. The [illegible] inguinal glands. [illegible] consequence primarily [illegible] there is an overgrowth [illegible] and trabeculæ. At [illegible] and this caseous mate- [illegible] later reaches the sur- [illegible] or partially ab- [illegible] which at times is very [illegible]

[illegible] into

the fresh air and sunlight as much as possible, and improving his general condition by the administration of milk, eggs, and other suitable foods in liberal quantities. Guaiacol carbonate, strychnin, quinine and even iron may be given internally. Counter-irritation over the enlarged glands may be resorted to, and the area may be painted with the tincture of iodin or smeared with ichthyol ointment. Where the glands are progressively enlarged and threaten to suppurate they should be removed.

The removal of tubercular glands which have not suppurated, and which are not surrounded by dense adhesions, is ordinarily not difficult. An incision should be made sufficiently long to freely expose the enlarged glands. If the submaxillary region is implicated, a curvilinear incision extending from below the ear to near the symphysis, and passing beneath the body of the inferior maxillary bone, will be suitable. If the glands are situated along the internal jugular vein, an incision behind the sterno-cleido-mastoid muscle is often most convenient. Care should be exercised not to wound the external jugular vein, and especially not to divide the spinal accessory nerve. Where the glands above and beneath the clavicle are enlarged it may be necessary to make an incision along the posterior border of the sterno-cleido-mastoid muscle to the clavicle and then to supplement this by a transverse incision along the upper portion of the clavicle. If the glands are found intimately adherent to the internal jugular vein, temporary ligatures may be placed about the vein above and below the adhesions before these are separated, in order to have the vein under control should it be wounded. In cases where the glands have suppurated it may be possible, if the capsule has not been perforated, to dissect out the glands without necessarily opening the capsule, and this should be done if practicable. Where there are strong adhesions to adjacent structures, and especially where the glands are broken down and their capsules are perforated, often all that can be done is to expose by incision the foci of pus formations, curette out the cavities, and then drain with wicks of iodoform gauze.

CARCINOMATOUS ENLARGEMENT OF THE LYMPHATIC GLANDS.

In carcinoma of any particular region the lymphatic glands which receive the lymph current from the particular area usually become enlarged. These glands seldom suppurate, but they may go on to perforation of the capsule, infiltration of the skin and the formation of offensive ulcers.

LYMPHOSARCOMA.

This condition has been to some extent mistaken for and confused with Hodgkin's disease.

Lymphosarcoma is a malignant disease, its sarcomatous condition engrafting itself upon or within the lymphatic glands, or it may be in these glands a primary condition. The process when fully established presents the symptoms and possesses the possibilities of malignant disease. Lymphosarcoma primarily, as it affects a few isolated glands in the neck, axilla or groin, may not be distinguishable from benign conditions, especially from tubercular disease producing enlargement of the same set of glands. The disease is rare, being in no way comparable in frequency with tubercular

adenitis or even to lymphatic leukemia. Primarily there is a simple enlargement of the glands, perhaps on one side of the neck. These glands present nothing especially characteristic, being round, freely movable, reasonably hard and without special pain. The condition, however, is constantly and, it may be, quite rapidly progressive. The adjacent glands become implicated and sooner or later the disease spreads to and envelops the glands of the opposite side of the neck, and perhaps also the glands beneath the clavicle and those in the axillary spaces. There is not only an increase in the number of glands implicated but also a steady increase in the size of those affected. The adjacent glands become fused together, the

Fig. [illegible] [illegible]

sarcomatous tissue [illegible] the capsule, but going into the adjacent tissue [illegible] immovable, perhaps irregular, [illegible] mass of tissue, which is inseparable from either of the [illegible] intervening or deeper tissues. In the cases which have come under my observation there have been later in the course of the disease metastatic [illegible] subcutaneous [illegible] different portions of the body.

The characteristics of [illegible] sarcoma after a few months' duration are: First, the growths are not confined to the lymphatic glands but [illegible]

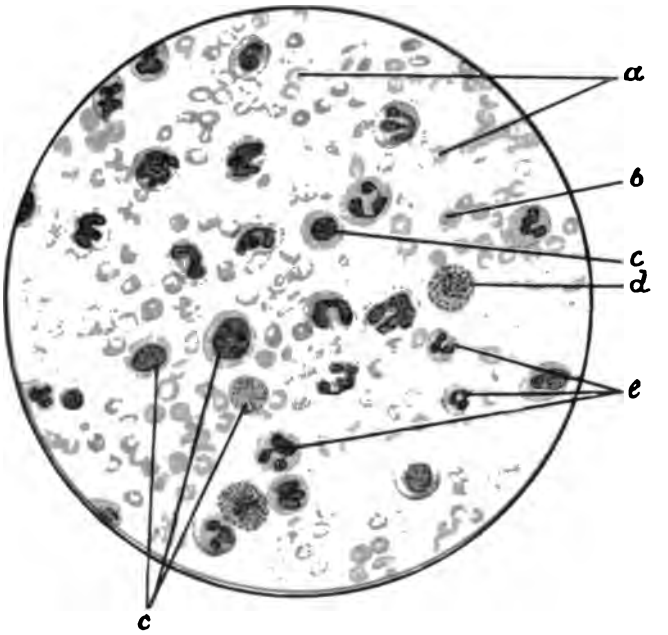


FIG. 338.

Blood in a case of spleno-medullary leukemia.

a. Red blood corpuscles.
b. Nucleated red corpuscle.
cc, Myelocytes.
d. Eosinophile cell.
e. Polymorph. neuclear leucocytes.

filtrate the adjacent tissue, converting the whole into a more or less hard, often extremely hard, immovable, solid mass. Second, there are often metastatic deposits situated in various portions of the body or within the viscera, and these grow with considerable rapidity. Third, the effect upon the constitution is far greater than in any other chronic lymphatic affection, and early leads to loss of strength, emaciation and death.

LEUKEMIA.

This subject is only considered here in consequence of the frequent enlargement of the lymphatic glands. Leukemia has been divided into spleno-medullary and lymphatic leukemia. In regard to the causation of leukemia but little is known. It occurs not infrequently in young adults.

Fig. [illegible]—Lymphatic Leukemia.

In my experience females have been affected more often than males, although this seems contrary to the general experience. It is supposed by some to be due to malaria, or injury, to a nervous condition, or to be of parasitic origin.

Morbid Anatomy. The patients often suffer from slight fever, are debilitated, and frequently reduced in flesh. In the spleno-medullary form the spleen is greatly enlarged, at times almost filling the abdomen; the liver is usually slightly enlarged, as well as the lymphatic glands. Characteristic changes also occur in the bone marrow, which is red and hyperemic. Occasionally there is an enlargement of the bones and tenderness of the periosteum. Microscopically there are present in the bone marrow large numbers of myelocytes, large cells with single large nuclei and neutrophilic

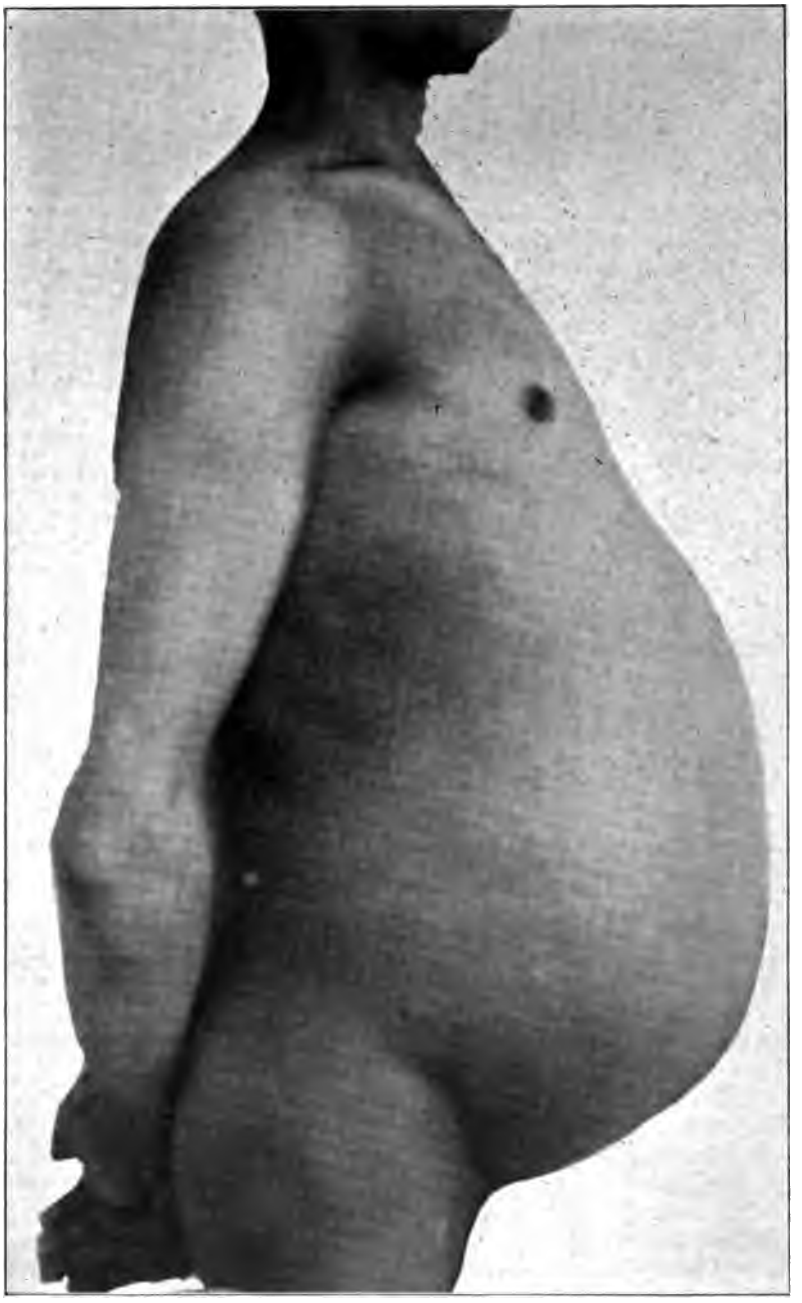
granules, large numbers of nucleated red corpuscles, also numerous large and small cells with eosinophilic granules. The lymphatic form is more common in young adults, and is more rapid and fatal in its course than is the spleno-medullary. In the lymphatic form there is general lymphatic enlargement—most marked in the neck, axilla and groin. In fact in lymphatic leukemia new growths may develop in almost any part of the body. The spleen and liver are usually moderately enlarged (Fig. 337). The lymphatic tissue in the tonsils, in the naso-pharynx and tongue may be implicated.

SYMPTOMS.—Fever is almost always present. In the spleno-medullary form the onset is insidious, the progress slow. The patient, however, becomes weak, debilitated and anæmic. There is shortness of breath and palpitation; the pulse is frequently rapid, soft and compressible; the abdo-

Fig. 340.—Lymphatic leukemia. Male, seven years old, died from exhaustion at seven and a half years.

men is often greatly enlarged. The increase in the size of the spleen is a characteristic symptom. This organ may extend to the navel or fill one-half or more of the abdomen.

The blood shows characteristic changes. The white blood corpuscles are increased from 8,000 per cubic mm. to as high as 300,000 per cubic mm. In the spleno-medullary form this increase is largely due to the occurrence of myelocytes, which are mononuclear, and to neutrophilic cells. They comprise about 30 per cent. of the white blood corpuscles. The red cells are reduced to about 2,500,000 per cubic mm., and the hemoglobin is generally reduced to 30 or 40 per cent. of the normal. In lymphatic leukemia the average increase of the white corpuscles is to about 150,000 per cubic mm., increase being due to the great number of lymphocytes.



ig. 341.—Spleno-medullary leukemia. Male, aged 29. Ill 11 months. Lost pounds. Very weak. Entire skin surface bronzed. Spleen extends to Poupa ligament on left side and into right side 3 inches beyond median line. Perp dicular measurement 20 inches; transverse 18 inches. Inguinal glands enlar Blood count: Red corpuscles, 3,125,000; whites, 172,880. Hemoglobin 55 per c

The hemoglobin is reduced to about 40 per cent. of the normal, and the red blood corpuscles to about 3,000,000 (Fig. 338).

DIAGNOSIS.—The recognition of leukemia and its two forms can be established by an inspection of the patient and a microscopical examination of the blood (Figs. 339 and 340).

PROGNOSIS.—This is usually unfavorable. In some of the acute cases of lymphatic leukemia a fatal termination is reached in two or three months. The majority, however, do not terminate fatally before two or three years. Hemorrhage, loss of flesh, dropsy and high fever are unfavorable signs. A few patients recover (Fig. 341, Spleno-medullary Leukemia).

TREATMENT.—The patients should be placed under the best possible hygienic conditions. They should have fresh air, sunshine, nutritious food and freedom from care or worry. Arsenic is often very beneficial and should be given in full doses. If there is a suspicion of malaria, quinine may be given; and if the patient is especially anæmic, iron should be administered. Operative measures directed to the removal of the enlarged glands are for the most part useless. The X-ray treatment has been tried, but apparently, in the great majority of cases, the benefit is only temporary.

HODGKIN'S DISEASE OR PSEUDOLEUKEMIA.

This is a disease characterized by progressive enlargement of the lymphatic glands, with anæmia and occasionally with the growth of lymphatic tissue in the spleen, liver and other organs.

ETIOLOGY.—A majority of the cases occur in young persons, and three-quarters of these in males. The condition has been ascribed to heredity, to syphilis and to infection.

MORBID ANATOMY.—The glands may be hard and firm or soft and elastic. At first they are small, distinctly separated and freely movable. At a later stage they become bound together into large tumors. The hyperplastic tissue may pass through the capsule of the glands and invade the adjacent structures. Occasionally suppuration occurs. The cervical glands are those most frequently affected; and there may often be traced a continuous chain from these glands to the axilla, or into the anterior mediastinum. The axillary glands are involved next in order, and then the inguinal and retroperitoneal glands are frequently invaded, and a chain not infrequently extends from the diaphragm to the inguinal canals.

The glands are homogeneous on section and it is often impossible to differentiate between the cortex and medulla. At times the fibrous stroma becomes quite noticeable. If the stroma is not increased the glands remain soft and usually grow rapidly. When the stroma is thickened the gland is hard and grows slowly. The spleen is enlarged in three-quarters of the cases and the liver is frequently enlarged (Fig. 342).

SYMPTOMS.—Enlargement of the cervical, axiliary and lymphatic glands is among the first indications of Hodgkin's disease. Occasionally the bronchial glands are primarily enlarged, producing dyspnœa, or the retroperitoneal glands may be enlarged, producing œdema of the feet. Anæmia may precede or follow the glandular enlargement. The spleen is usually palapable and the liver enlarged. There is usually a palpitation with hemic murmurs. Fever of a mild degree, at times hectic in character,

is usually present. An examination of the blood will show an anæmia, the red corpuscles being reduced on an average to 3,000,000 or 4,000,000, while the whites are not especially increased.

DIAGNOSIS.—Hodgkin's disease can be differentiated from leukemia by an examination of the blood; it can be differentiated from tubercular lymphadenitis usually by its more rapid course, and by the further fact that there is greater prostration and more fever in Hodgkin's disease;

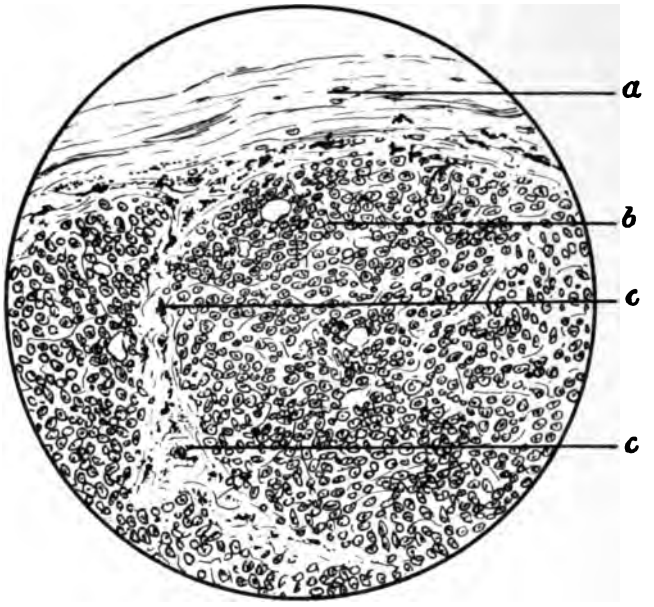


Fig. 342.—Lymphatic gland. Pseudo-leukemia. a. Capsule. b. Lymph follicle. c. c. Pigment in the lymph sinuses.

moreover, in Hodgkin's disease the axillary and inguinal glands are usually enlarged to such an extent as to form tumors of quite considerable size.

The prognosis is unfavorable.

TREATMENT.—Arsenic should be given in full doses and is quite often beneficial. In some cases benefit has been derived from a removal of the glands.

CHAPTER XVIII.

FRACTURES.

A fracture may be defined as the forcible destruction of the continuity of bone.

Fractures may be divided into (a) Simple, those in which there are no complications and the bone is broken in but one place; (b) Compound fractures, those in which the soft tissues are torn or divided over the bone and the fractured surfaces are directly exposed to the external air; (c) Pathological fractures or those caused in consequence of disease of the bone, which occur without the application of much force; (d) Ununited fractures, those in which union has not taken place after a time sufficient ordinarily for repair; (e) Spontaneous fractures, those which occur in consequence of the application of a trifling force; (f) Incomplete or "green-stick" fractures, those in which the bone is only partially broken; (g) Complete fractures, those in which the bones are completely broken across; (h) Comminuted fractures, those in which the bones are broken into several pieces; (i) Multiple fractures, where several bones are broken at the same time; (j) Gunshot fractures, produced by a missile which has derived its force from the explosion of gunpowder.

In 51,938 cases treated in the London hospital, the fractures were classified as follows:

Fractures of the skull	757
Fractures of the face	1,245
Fractures of the spine	172
Fractures of the pelvis	142
Fractures of the coccyx	15
Fractures of the ribs	8,261
Fractures of the sternum	52
Fractures of the scapula	425
Fractures of the clavicle	7,840
Fractures of the arm	4,084
Fractures of the forearm	9,440
Fractures of the head	5,755
Fractures of the thigh	3,242
Fractures of the patella	664
Fractures of the leg	8,323
Fractures of the foot	1,521
Total	51,938

Fractures are further classified according to their extent, seat direction into complete and incomplete fractures.

INCOMPLETE AND COMPLETE FRACTURES.—*Incomplete fractures* divided into (a) fissured; (b) "greenstick" fractures; (b) depressed fi tures.

Complete fractures have been divided according to the direction line of fracture, into, (a) transverse or oblique, longitudinal, V-shaped T-shaped; (b) according to the seat of fracture, into fracture of sh neck, condyle and separation of an epiphysis; (c) in reference to the of fracture in relation to a neighboring joint, into intraarticular, ex articular and intracapsular.

Mode of production of fracture: Those produced by direct violei by indirect violence, and by muscular force.

The displacements of the fractured end of the bone may be divi into six classes: First, the transverse or lateral displacement. In form the broken ends of the bones are separated at a right angle to long axis. The separation may be complete or incomplete. Second, an lar displacement. In this form the upper or lower fragment divides ruptly from the line which represents the normal axis. Third, rotat In this displacement one of the fragments is rotated on its transverse a Fourth, overriding. This usually occurs in oblique fractures and is cau by the impact of the injury and by muscular contraction. The fractu surfaces overlap and the articulating exremities of the bone are appr imated. Fifth, impaction or crushing. In this variety one of the fractu ends is driven into the other, producing shortening and deformity. Si longitudinal separation. This condition occurs in transverse fractures the patella and the olecranon process, the two fragments being separa by muscular contraction.

PREDISPOSING CAUSES OF FRACTURE.—Advanced age is an import predisposing cause of fracture. The bones become rarefied, atrophied, break more readily than in adult age. Pathological processes are also quent predisposing factors. In carcinomatous processes, and especially carcinoma of the breast, one or more of the long bones frequently beco infiltrated and its texture more or less destroyed. In consequence of a fracture more readily occurs on the application of even a slight force. osteomyelitis, osteomalacia and in fragilitas ossium, fractures are freq in consequence of the destruction, or excessive brittleness, of the bone.

The immediate causes of fracture are direct or indirect violence muscular action.

Fractures by *direct violence* are those in which the break occurs at site of a blow.

In fractures by *indirect violence* the break occurs at some point dist from the seat of the injury, as, for instance, a blow upon the vault of head may fracture the base of the skull, or a fall upon the feet may fr ture one of the bones of the leg, or one of the spinal vertebræ.

Fractures by *muscular action*: These usually do not occur unless muscular contractions are violent, and in a measure unexpected. In sud muscular contraction of the quadriceps or the triceps, the patella or cranon may be broken.

SYMPTOMS OF FRACTURE.—The chief symptoms of fracture are deformity, abnormal mobility, crepitation and loss of function.

Deformity: This is practically always present in fractures, and is due primarily to the displacement of the ends of the bone, and secondarily to the swelling. The deformity is usually marked and readily recognized on inspection. In fractures of the long bones the deformities which are most noticeable are those due to angular displacement, or rotation of the distal portion of the limb, and to shortening.

Abnormal mobility: By this is meant that motion which occurs at the site of a fracture where normally there should be none. When a fracture occurs through the shaft of the femur or humerus, or through both bones of the leg or forearm, this abnormal mobility is usually very marked and easily recognized. If the fracture occurs near a joint, or through one of the bones of the leg or forearm, abnormal mobility may be difficult of recognition. On the other hand the very free motion in a loose joint may be readily mistaken for the abnormal mobility of a fracture, if one is not on his guard.

Crepitus: This is a rough grating which occurs when motion is imparted to the fractured surfaces, provided they are in contact. Crepitation is caused by the rubbing of the ends of the bones together. It is a harsh, grating sound which usually can be distinctly heard, and the condition is readily appreciated by the fingers. Crepitus must not be mistaken for the softer but still grating sound which is often heard in normal joints or in those the site of a slight plastic synovitis when motion is imparted to the joint.

Mobility occurring in the shaft of a long bone, attended with crepitus, is pathognomonic of fracture.

Loss of function: As a rule, loss of function is complete after fracture of one of the long bones. After a fracture of the femur or humerus the patient is unable to lift the leg from the bed or raise the arm from the side. In a fracture of the fibula, or of one of the bones of the forearm, the patient may be able to walk some distance, or use the arm.

Shock and pain: In fractures there is usually pronounced shock followed by very severe pain, the latter being aggravated by motion in consequence of the ends of the bone nagging the flesh.

Swelling: Pronounced swelling usually occurs at the site of the fracture, followed by ecchymosis. The swelling is due to the rupture of the blood and lymphatic vessels and to the inflammatory exudate.

REPAIR OF FRACTURES.—In studying the repair of fractures one should remember that bone is but a dense form of connective tissue, which has been infiltrated with lime salts. The process of repair in fractures does not differ materially from the repair of the soft tissues and the healing of wounds, except that in bone we have osteoblasts which proliferate and produce bone, instead of fibroblasts producing connective tissue. In the breaking of a bone there is more or less extensive rupture of the periosteum and endosteum, laceration of the blood vessels and injury to the soft tissues. As a result of this injury hemorrhage occurs into the surrounding tissues, followed by traumatic inflammation, and an inflammatory exudate. In consequence of the tearing of the blood and lymphatic vessels and the inflam-

matory exudate, the part becomes markedly swollen. The blood clot and the shredded and broken-down tissue are later removed by phagocytosis. About the second day following a fracture, the deepest layer of cells of the unbroken surrounding and adjacent periosteum and endosteum, begins to proliferate actively, and forms a dense osteoid tissue. At the same time the osteoblasts lining the Haversian canals and the bone corpuscles within the lacunæ at the broken extremities of the bone, take on active proliferation, producing an osteoid tissue which unites with that coming from the periosteum without, and the endosteum within. The osteoid tissue is known as the provisional callus. Its formation begins about the fourth day, and by the end of the first week the ends of the bones are fairly well supported by it. This provisional callus is but a dense granulation tissue and does not contain lime salts, Haversian canals or lamellæ.

THE CONVERSION OF CALLUS OR OSTEOID TISSUE INTO BONE.—During the formation of callus new vessels extend into it from the periosteum, endosteum and ends of the bones, the same as they do in new granulation tissue. The walls of the canals bearing the blood vessels are lined with medullary cells known as osteoblasts, which as soon as the vascularization is complete, form bony lamellæ about the vessels, and, following this, Haversian systems are established, and the callus is converted into true bone, and union is complete. Succeeding this the periosteal and medullary calluses are gradually absorbed. This process may require years. The time necessary for the healing of the bone depends largely upon its size and the age of the patient.

The callus which is formed from the periosteum is known as the periosteal callus; that which comes from the medulla is known as the myelogenic, and that which is placed between the ends of the bones, as the definite callus.

THE TIME REQUIRED IN THE HEALING OF BONES.—A broken phalanx will usually unite in about two weeks. Three weeks are usually required for a broken wrist; five weeks for a bone of the forearm; six weeks for the humerus; seven weeks for the tibia; and ten weeks for the femur.

COMPLICATIONS OF FRACTURES.—By complications are meant such conditions as are not incident to the fracture, and which aggravate the injury, prolong the treatment or render the result less satisfactory.

Among the immediate complications may be mentioned a tearing of the overlying soft structures, rendering the fracture compound and exposing it to the air. If infection occurs suppuration is likely to follow, necessitating frequent dressing, increasing the pain and distress, prolonging the treatment and often delaying or even preventing union.

COMMINUTION OF THE BONE.—In this condition, if the fracture is compound, it is often necessary to remove pieces of bone which have been largely stripped of their periosteum. In cases which are not compound union is delayed, a larger callus is required and the results are ordinarily less perfect.

LACERATION OR THROMBOSIS OF IMPORTANT BLOOD VESSELS.—This complication occasionally occurs near joints and especially at the lower end of the humerus or femur. If the brachial or popliteal vessel is lacerated, thrombosed or obstructed by pressure, a large hematoma or traumatic aneurism

may result, requiring incision and turning out of the clot, or ligation of the injured vessel. In some cases in consequence of injury to an important vessel, gangrene may result, necessitating amputation.

INJURY TO NERVES.—Important nerves, such as the musculo-spiral or ulnar, are occasionally injured or lacerated, causing paresis or paralysis of the muscles which they supply.

FRACTURE EXTENDING INTO JOINTS, OR COMPLICATED BY DISLOCATIONS. —A fracture not infrequently extends into a neighboring joint, or may be associated with a dislocation greatly aggravating the condition and often making the result less favorable.

MEDIATE OR LATE COMPLICATIONS.—These may occur during the process of healing.

FAT EMBOLISM.—This condition may occur in fractures which are not early immobilized and are subjected to considerable motion. The process is most frequent in childhood and in young adults. It usually makes its appearance during the second or third day and is attended with marked restlessness, difficulty of respiration and rapid pulse. In the process the capillaries of the lungs, kidneys and brain frequently become obstructed by fat emboli. Fat particles can frequently be seen on the surface of the urine. The treatment should consist in supporting the circulation.

SWELLING.—This may be so great in consequence of inflammatory exudate, and the rupture of blood and lymph vessels, as to compromise the circulation and threaten the vitality of the limb. If the swelling is extensive and is not relieved by immobilization and supported by proper bandaging, incisions may be necessary even at the risk of rendering the fracture compound.

MUSCULAR SPASM.—This condition can scarcely be considered a complication, as it practically always occurs in fractures of the thigh, leg and arm. It often causes severe and excruciating pain, and in oblique fractures produces overriding of the fractured surfaces. It is to be treated by the application of suitable traction and immobilization.

DELIRIUM TREMENS.—This is one of the most serious conditions complicating fractures. It frequently occurs in persons who are habituated to the use of alcohol, and who in consequence of the injury are obliged to remain in bed. It should, if possible, be guarded against by the administration of alcohol in proper quantities, and in securing for the patient a full measure of sleep by the administration of chloral, bromide, or codein. If delirium occurs hyoscyamine, morphine or chloral are at times serviceable. The delirium is often so severe that the patient has to be forcibly restrained or put into a straight jacket.

STIFFNESS OF ADJACENT JOINTS.—This is predisposed to by a rheumatic diathesis or rheumatoid arthritis, by age and by sex. Females past fifty years of age are especially liable to suffer from stiffness of the phalangeal joints after a broken forearm. Immobilization of the joints and long continued pressure upon muscles and tendon sheaths are the immediate factors. The condition can, in a large measure, be guarded against by releasing joints as soon as possible, and by substituting plaster of Paris casts for splints. Passive and active motion, and massage should be early resorted to.

ATROPHY OF THE LIMB.—More or less of atrophy always occurs in

cases of fracture. It is due to non-use, lessened blood supply and the pressure of splints. The condition is usually soon recovered from, after the splints are discarded, by using the limb and having it massaged.

PAIN, SWELLING AND WEAKNESS OF THE LIMB.—These often persist for months after the healing of the fracture, and they may even be permanent. They are largely due to pressure upon, or adhesions about, nerves, tendon sheaths, or muscles; to imperfect union; to interference with return lymphatic circulation and to stiffness of the neighboring joints. These complications may often be prevented by a more perfect adjustment of the fractured surfaces, by complete immobilization and by preventing undue pressure of splints upon the soft tissues. Pain, swelling and weakness may often be relieved in time by massage and the application of a suitable bandage.

EXCESSIVE CALLUS.—This is due either to imperfect immobilization, or to the fact that the fractured surfaces were not in good apposition. The preventive treatment is more perfect adjustment and complete immobilization.

FAULTY OR VICIOUS UNION.—This results from want of proper adjustment of the fractured surfaces or to incomplete immobilization. In consequence of faulty union, deformity is often produced and the usefulness of the limb greatly impaired. Angular displacement or rotation can usually be corrected by manual force, if attempted while the callus is soft. After the callus has become bony, correction cannot be accomplished without refracturing the bones. Osteotomy is usually practised in these cases, the bone being cut through with a chisel, when the deformity is corrected and the limb put up in splints.

DELAYED UNION.—This term is applied to those cases in which, though union is taking place, it is not completed in the ordinary time. Delayed union is due to a variety of causes: (a) Imperfect immobilization; (b) Want of complete adjustment of the fractured surfaces; (c) Disease of the bone; (d) Constitutional disease; (e) Poor health.

In the treatment of these cases the cause, if possible, should be corrected, the fractured surfaces more perfectly immobilized, and the patient got out of bed and into the fresh air. The general health should, if possible, be improved, and the circulation in the limb increased. In fractures of the lower extremity this may be attained by getting the patient out of bed and on his feet; or the ends of the bone may be vigorously rubbed together by manipulation. The fractured area may be hammered with a padded mallet, or the ends of the bones may be stimulated by boring them with a gimlet, and, if thought best, inserting ivory pegs.

FIBROUS OR LIGAMENTOUS UNION.—In this condition the ends of the bones are connected by fibrous tissue. The connection may be so close as to permit of very limited motion, or so loose as to allow of free motion. The causes are non-adjustment of the ends of the bone, imperfect immobilization, or the presence between the ends of the bone of muscle fascia or blood clot. If the union is close no treatment is required. If there is free motion the treatment outlined for delayed union may be practiced. If this does not succeed the ends of the bones may be exposed, freshened, brought together and, if thought best, wired. If the ligamentous union occurs in

one of the bones of the leg or the forearm, it may be necessary to resect a portion of the adjacent bone in order to bring the ends of the fractured bone together.

NONUNION.—Here little or no reparative action has taken place. The ends of the bones are usually atrophied, pointed and unconnected. The condition is rare. It is usually due to malnutrition, but may be caused by the factors which lead to delayed or ligamentous union. In the treatment the ends of the bones should be stimulated, the blood supply increased, and, if necessary, the ends of the bones freshened and wired.

SPECIAL FRACTURES.

FRACTURE OF THE NASAL BONES.

These fractures are of frequent occurrence and due to blows or falls upon the nose. The degree of injury may vary from slight deflection of the cartilaginous septum or fracture of the projecting ends of the nasal bones, to the complete breaking down of the bony arch of the nose, with fracture of the perpendicular and cribriform plates of the ethmoid. The condition is usually readily recognized if seen early and before marked swelling has occurred. If seen late and after pronounced swelling, it may be impossible to recognize the fracture. According to the situation and extent of the fracture, the deformity may consist in a depression of, or a sinking in of, one side of the nose, or the nose may deviate to one side, or the bridge may be broken down, or the tip of the nose depressed.

TREATMENT.—The parts should be replaced in their normal position. This can usually be effected by external manipulation with the fingers. In cases in which there is marked depression the parts will have to be elevated by a small but very strong instrument, which can be introduced into the nostril. A suitable instrument for this purpose is the ordinary steel sound, which may be covered with a bit of cotton and then introduced well into the nose and the depressed bone elevated. This often requires very considerable force, as there is frequntly markd impaction. If there is a tendency for the parts to become redisplaced, which is frequently the case, they may be retained in position by packing narrow strips of iodoform gauze firmly within the nostril. This should be renewed every day and the nostril gently syringed out with some mild antiseptic solution. The treatment must be continued for a week or ten days. Occasionally the cartilaginous septum is loosened and forced to one side. This may be corrected by forceps pressure, or by packing. The importance of early recognizing and perfectly correcting any deformity of the nose due to fracture can scarcely be overestimated, as the subsequent deformity is very marked and unsightly.

FRACTURES OF THE SUPERIOR MAXILLARY BONE.

These fractures are comparatively rare. They are generally produced by direct and severe violence. A portion of the alveolar process may be broken off by direct violence, as in blows or falls upon the face or in the extraction of teeth. The loosened portion can usually be held in position by binding the lower jaw against the upper, and if necessary by wiring on each side the teeth of the sound portion to those of the fractured. Occa-

sionally as the result of a fall from a height upon the face, one or both bones are loosened from their attachment and carried backwards so as to close the nasopharynx, and flatten the face very materially. Reposition can usually be effected in these cases by introducing the finger into the mouth and behind the palate and dragging the maxillary bones forward into position. In these cases difficulty may be experienced in retaining the bones in position, as they are quite loose and tend to fall backwards. In such case constant traction may have to be maintained, for a week or more, or the teeth of the upper jaw may be securely wired to those of the lower. Profuse suppuration usually follows in these cases and one's constant endeavor should be to keep the parts in as clean a condition as possible, by frequent syringing the nose and mouth with some mild antiseptic solution.

FRACTURE OF THE MALAR BONES.

These fractures are rare and only occur as the result of severe violence. The orbital and zygomatic processes may be broken separately, or the entire bone may be separated from its connection and forced out of position. In these latter cases the malar process of the superior maxillary is also broken. In fractures of the malar bone the displacement may occur in one of three directions, viz., backward into the zygomatic fossa, inward into the antrum of Highmore, or forward and upward into the orbit. The deformity is usually pronounced, even when the cheek bone is but slightly displaced. Crepitus and preternatural mobility may be wanting on account of the impaction. If the displacement is backward the movements of the lower jaw are likely to be interfered with, and if the displacement is into the orbit, the eye will be protruded.

TREATMENT.—If the displacement is at all marked every effort should be made to effect a reduction of the fragments. This may at times be accomplished by manipulation. The finger can be introduced into the zygomatic fossa, into the orbit and beneath the bone, and an effort made to force it into position. If one does not succeed by manipulation, a small opening can be made in the soft parts and a gimlet bored into the bone, with which it is dragged into position.

FRACTURE OF THE LOWER JAW.

This is of frequent occurrence and is caused by falls or blows upon the chin or side of the face. The fracture may be single, double or multiple, and is most frequently situated anteriorly between the symphysis and mental foramen. No portion of the bone is, however, free from liability to fracture, but the body is much more frequently broken than is the ramus, while the condyle or coronoid processes are but rarely fractured. In fracture of the body the line of fracture is usually transverse or slightly oblique. The fracture is usually compound, the muco-periosteal covering within the mouth being torn.

There is usually some lateral displacement, with depression of one of the fragments. Diagnosis is readily made from the history of the accident, bleeding from the mouth, want of alignment of the teeth, and crepit

The prognosis is usually good. In multiple fractures, however, attended with profuse suppuration, the endurance of the patient may be severely taxed.

TREATMENT.—Replacement of the fragments in proper position is usually readily effected by manipulation in simple cases. In cases in which there is little tendency to displacement the application of a four-tailed bandage (Fig. 14) may be all that will be necessary. Ordinarily, however, a trough should be made for the lower jaw out of binder's board, or canton flannel and plaster of Paris. To form this trough for an adult a piece of binder's board eighteen inches long by three to four inches wide should be immersed in cold water until reasonably soft. The center of each end is then split down for about two and a half or three inches and a portion of the middle third trimmed away so as not to make undue pressure upon the throat or upon the lip. The central portion is then applied, and accurately molded to the chin, while the two extremities are molded to the jaw. The splint is held in place by a four-tailed, or figure-of-eight, bandage, and when dry gives good support (Fig. 343). A trough may be made of canton flannel, or coarse cloth, and plaster of Paris as follows: a piece of the cloth eight inches long, doubled three times, and three or four inches wide,

Fig. 343.

is saturated with plaster of Paris cream, has its two ends split down for two or three inches, the upper and lower portions trimmed away, so as not to make undue pressure upon the lower lip and throat, and then accurately applied and molded to the chin and lower jaw and held in position by a figure-of-eight bandage. After drying it should be removed and lined with absorbent cotton or gauze, when it makes an excellent trough in which the lower jaw may be quite firmly and accurately retained in position following the fracture.

In cases in which there is marked tendency to displacement, and especially those in which the fracture is double, it is often of decided advantage, in addition to the application of the trough, to wire the teeth of the loose piece firmly to the corresponding teeth of the upper jaw, and then bind the jaws together. Vulcanized or aluminum interdental splints are often made use of by oral surgeons in the treatment of fractures of the lower jaw, and especially in those which are multiple and held in position with difficulty. In fractures near the angle of the jaw, or through the ramus, with marked tendency to displacement in consequence of muscular contraction, it may be, and often is, necessary to wire the fragments together through an open incision. In doing this the fractured surfaces are exposed by incision, when two holes are made with a bone drill through each fragment. These holes are in pairs and should corresp[illegible] fractured surfaces.

Silver or annealed iron wire is then passed through each pair of openings and the fractured surfaces brought firmly together. In severe cases of comminuted fracture, as in those caused by the kick of a colt or horse, it may be impossible to retain the fragments in position. In these cases they should be removed.

In fractures of the jaw, and especially in those which are compound, it is absolutely necessary to maintain the mouth in as clean a condition as possible. In cases in which the teeth of the upper and lower jaws are wired together the patient can ordinarily be given liquid food through some point where a tooth is absent, or nourishment may be administered through a soft catheter, passed through the nose and into the stomach, or he may be fed for a few days per rectum.

FRACTURES OF THE HYOID BONE.

Fractures of this bone are rare in consequence of its protected position and free mobility. Fractures may, however, occur as a result of blows or falls upon the neck, or as a result of forcibly clutching the throat with the hand. The fracture has usually been situated near the junction of the great cornu with the body of the bone.

SYMPTOMS.—Locally there is tenderness, swelling and ecchymosis. The movements of the lower jaw and tongue are painful. Deglutition is often difficult and it may be impossible. If the thyroid cartilage is implicated there is likely to be severe dyspnœa with cough and bloody expectoration.

TREATMENT.—The displacement can usually be corrected by manipulation, and if necessary by introducing a finger within the pharynx. After replacement the head and neck should be immobilized with bandages passing around the head and shoulders (Fig. 72). If the swelling is considerable cold compressed may be applied to the neck. If the pain and difficulty of swallowing are considerable, the patient should be nourished by rectal enemata.

FRACTURE OF THE STERNUM.

Fracture of the sternum is rare, largely on account of the elasticity of its supports and its own porous and elastic nature. When fracture does occur it is usually the result of a severe crushing force, and is frequently associated with injuries to other structures.

SYMPTOMS.—The symptoms are local tenderness, swelling with deformity and often crepitus. There is also frequently, even in uncomplicated cases, severe pain in the sternal region. There may be associated injuries with dyspnœa, cough and bloody expectoration. The fracture is usually transverse and situated in the upper part of the gladiolus, with the upper end of the lower fragment projecting forward. Union usually readily occurs, even if reduction is not completely effected.

TREATMENT.—The projecting fragment can usually be forced into position by manipulation, and maintained at least in part by the application of a compress held in position by a wide bandage which encircles the chest, or by a wide piece of adhesive plaster. The patient is most comfortable in a half-sitting posture with a hard pillow between the shoulders. This position also assists in maintaining the fragments in proper position.

FRACTURE OF THE RIBS.

Fracture of one or more ribs is of very frequent occurrence. The fracture is usually caused by falls, direct blows in consequence of which the rib or ribs are forced inwards and broken, or it may be the result of the flattening of the chest by antero-posterior pressure forcing the ribs outwards and causing a fracture. The immediate displacement of the ends of the fractured rib may be considerable, causing laceration of the pleura or lung, or rupturing an intercostal artery. Other complications may occur, depending on the degree and extent of the traumatism. Injury or laceration of the pleura will lead to a pleurisy usually plastic in character. Laceration of the lung is likely to be followed by traumatic pneumonia, or perhaps severe hemorrhage into the pleural cavity (Hemothorax).

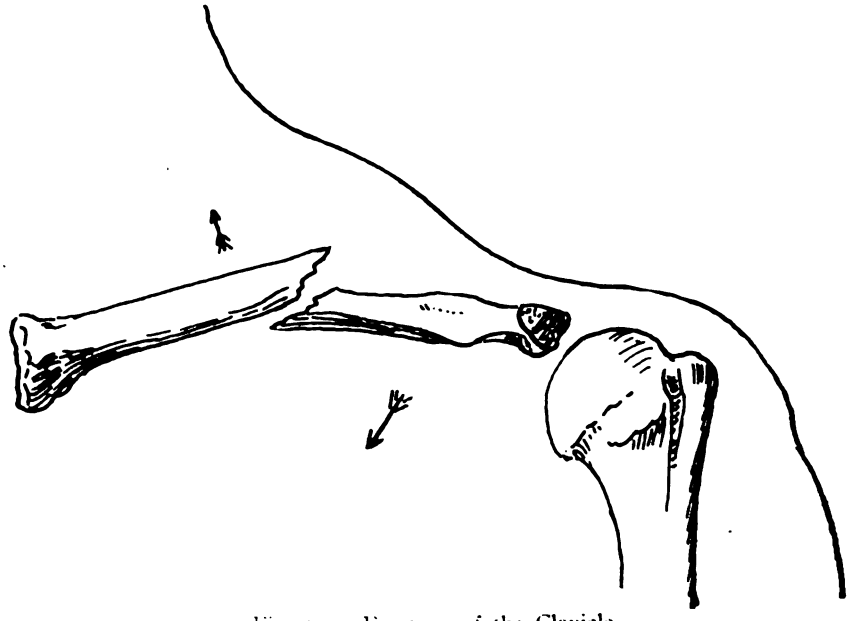


Fig. 314.—Fracture of the Clavicle.

SYMPTOMS.—In the fracture of a rib there is a sudden, acute, intense pain of a lancinating character, felt over the area of the broken bone. Respiration is interfered with and if prolonged, very painful. Consequently the respirations are short and quick. There is often a dry, troublesome and very painful cough. Without complications there is but little fever; with complications the fever will depend upon the kind, degree and extent of the complications. Locally there is a well circumscribed tender area. If pressure is made upon this point a severe stabbing pain is produced. There is some swelling, often ecchymosis, and, it may be, crepitus and preternatural mobility. Crepitus and preternatural mobility, however, in fracture of a single rib, are difficult to determine. If two or more ribs are broken, crepitus and increased mobility are easily recognized. Without crepitus and preternatural mobility the diagnosis is made by considering the history of

the case, the stabbing pain in the side when the patient takes a long breath, coughs or reaches upward with the arm, associated with localized tenderness, swelling and severe pain upon pressure.

TREATMENT.—This usually consists in restraining the freedom of the chest wall by suitable bandages, or a wide strip of adhesive plaster. Ordinarily a compress should not be placed over the seat of the fracture preceding the application of a bandage, as this is likely to force the ribs inward

Fig. 345.—Sayres' dressing for fractured clavicle.

and produce irritation of or injury to the pleura or lung. A strip of adhesive plaster six inches wide and sufficiently long to encircle more than one-half the body, should have its center applied over the seat of the injury, and then at the end of an expiration, brought firmly about the chest. This limits the expiratory movements, supports the chest and relieves very materially the pain.

FRACTURED CLAVICLE.

The clavicle is probably more frequently broken than any other bone in the body, excepting the radius. The fracture occurs most frequently during childhood and young adult age. The cause is ordinary and indirect force, as a fall upon the outstretched hand, upon the elbow, or upon the point of the shoulder. Occasionally the clavicle is broken by direct force, as from a blow or kick received directly over the bone.

SITUATION AND DISPLACEMENT.—The fracture is usually situated in the outer portion of the middle third of the bone, just internal to the attachment of the coraco-clavicular ligament. The direction of the fracture is ordinarily from above downwards and inwards. The external fragment is held down by the attachment of the coraco-clavicular ligament, while the shoulder, losing the support of the clavicle, falls downwards, inwards and forwards, carrying the outer fragment with it and producing overriding. This displacement of the shoulder and the possible contraction of the sterno-cleido-mastoid muscle make the fractured end of the internal fragment project forcibly beneath the skin (Fig. 344).

Fractures of the outer third are much less frequent than those of the middle third, and when occurring the fracture is often transverse with an angular deformity, the apex of which projects upwards and backwards.

Fractures of the internal third of the clavicle are rare, and in this situation the fracture is often transverse, the fragments usually not separated materially, and the deformity angular with the apex directed upwards.

In children greenstick fracture may occur. If the fracture has been produced by direct force, as from the kick of a horse, it may be compound. Fractures of both clavicles have occurred as the result of a transverse crushing of the shoulders between heavy objects, or from direct force.

SYMPTOMS.—There are pain, local tenderness, swelling, ecchymosis and deformity, the extremity of the internal fragment projecting prominently beneath the skin. There are abnormal mobility, crepitus and loss of function in the corresponding member, the patient supporting the forearm and elbow of the injured side with the hand of the well arm. There is a falling downward, forward and inward of the shoulder, with over-riding of the fractured surfaces, and approximation of the ends of the clavicle.

COMPLICATIONS.—Complications are rare, although in a few cases the brachial plexus or the subclavian or internal jugular vein has been injured. Union readily occurs in the great majority of cases in about four weeks, although with some displacement.

TREATMENT.—In some cases in children without marked displacement no special treatment is required further than the support of the arm in a sling.

In cases of oblique fracture with marked separation, the fragments should be adjusted by carrying the shoulder upward, backward and outward. In the great majority of cases it is difficult and almost impossible to maintain the arm for any length of time in this position, and the fractured surfaces absolutely in contact and without deformity. The Sayres' dressing is perhaps resorted to more frequently than any other, either as originally planned or slightly modified. This consists (as shown in Figs. 345 and 346) in looping a wide strip of adhesive plaster about the injured

and then carrying the strip across the back, then across the chest
ath the arm so as to hold the arm firmly backwards. A pad is
d in the axilla, and a broad strip of adhesive plaster, which ha
r fenestrated, is placed with this point over the olecranon of the in

Fig. 346.—Sayres' dressing for fractured clavicle.

ber and the two ends carried across the opposite shoulder, whil
is forced upwards and forwards. Additional security may be
e Sayres' dressing by a few turns of bandage about the elbow
or by applying a modified Velpeau bandage.

When it is very desirable to avoid deformity the patient should be placed in bed with a hard pillow between the shoulders, as this will take the weight of the upper extremity and shoulder off from the fracture, and relieve very materially the displacement. Some prefer to place large padded rings about the shoulders and bind these firmly together posteriorly, dragging both shoulders backwards.

The retentive dressings in fractured clavicle are always very irksome and frequently not well borne. In some cases especially in children it is almost impossible to make them submit to the Sayres' dressing. In these a Velpeau bandage may well be applied to the side, fixing the shoulder and at the same time giving the arm some support.

FRACTURES OF THE SCAPULA.

These fractures are rare and are usually the result of the application of great violence, as that which may occur in falls from a height.

FRACTURES OF THE BODY OF THE SCAPULA.

These may be transverse or comminuted. The scapula being superficial is easily palpated, and preternatural mobility, crepitus, tenderness and swelling, when occurring, are readily made out. In fracture of the body of the scapula there is usually marked functional disability of the corresponding arm.

FRACTURES OF THE ACROMION PROCESS OF THE SCAPULA.

In the treatment the scapula should be fixed to the side by the application of a broad strip of adhesive plaster or by the application of a wide bandage. The arm is supported in a sling.

This process unites with the scapula about the twentieth year. Fracture or separation of the epiphysis usually occurs as the result of direct force, such as a fall or blow upon the point of the shoulder. In fractures of the acromion, the line of separation is usually outside of the acromio-clavicular ligament.

SYMPTOMS.—There will be localized tenderness, some flattening of the shoulder, crepitation, swelling, functional disturbance and preternatural mobility.

TREATMENT.—The arm should be supported in a sling and the shoulder elevated by a suitable bandage. Such a support may be constructed with a bandage three inches wide, which is carried twice around the body for purposes of fixation, and then over the arm just above the elbow. From this point it is carried across the back and over the injured shoulder internally to the break, down beneath the arm and elbow, and again around the body. These turns may be continued till the part is sufficiently fixed.

FRACTURES OF THE SPINE OF THE SCAPULA.

This fracture is caused by direct violence, and either the entire spine may be broken off or only a portion, leaving the acromion process attached to the body of the bone. The displacement is usually slight and easily corrected.

TREATMENT.—In the treatment a compress should be adjusted around and over the spine, and the scapula immobilized by several turns of a bandage about the chest and over the corresponding shoulder.

FRACTURES OF THE CORACOID PROCESS.

This process is well protected and seldom the seat of fracture. Fracture may, however, occur as the result of muscular action or direct violence.

The symptoms are increased mobility, crepitus and pain, with functional disturbance of the arm and pain upon motion.

The treatment should consist in immobilizing the arm to the side and giving it support. The union is usually fibrous, in consequence of the displacement, which is caused by the contraction of the attached muscles.

FRACTURES THROUGH THE GLENOID FOSSA, OR SURGICAL NECK.

These fractures may occur as a complication of dislocations, the rim of the fossa being broken by the head of the humerus as it is leaving the cavity.

Fractures of the cervical neck are spoken of as comprising all cases in which the detached portion includes the attachment of the long head of the triceps.

The upper line of fracture may pass through the supra-clavicular notch, or be placed externally to the coracoid process. These fractures are produced by indirect violence, as a fall upon the outstretched hand, upon the elbow or shoulder. The symptoms are represented by great pain, loss of function in the arm, flattening of the shoulder in consequence of the loss of support of the triceps, and crepitus. The flattening of the shoulder will be greater when the line of fracture extends through the supra-scapular notch, because then there is loss of support of the coraco-clavicular ligament.

The treatment consists in elevating and fixing the arm for from four to six weeks, with a Sayres' or Valpeau's bandage, either of which may be modified to suit conditions.

FRACTURES OF THE HUMERUS.

These fractures are of frequent occurrence. They may be produced by direct or indirect violence. They frequently are caused by falls upon the hand, elbow or shoulder, and by direct blows. For convenience of description fractures of the humerus may be divided into those occurring above the insertion of the pectoralis major, those through the shaft and fractures above and through the condyles.

FRACTURES OF THE HEAD, OR INTRACAPSULAR FRACTURES.

These are comparatively rare, but when occurring are usually compound and the result of gunshot injuries of the joint.

The treatment in these cases, if without infection, is that of readjusting, so far as is practicable, the fractured surfaces, and then immobilizing the shoulder and arm against the chest.

to outline the seat and extent of the fracture, and more perfectly to adjust the fractured surfaces. In adjusting the fracture the surgeon fixes the shoulder and upper fragment with his left hand, and grasps the injured arm above the elbow with his right, when he makes extension, rotation and manipulation until the fragments seem to be in position. If the deformity can be corrected, a proper alignment of the fractured surfaces secured, and the shortening practically overcome, the surgeon may be reasonably certain that the fractured surfaces are in good position. The bones are then maintained in position by a molded and padded splint which extends from the axilla to the flexed forearm, and is made to surround the internal surface of

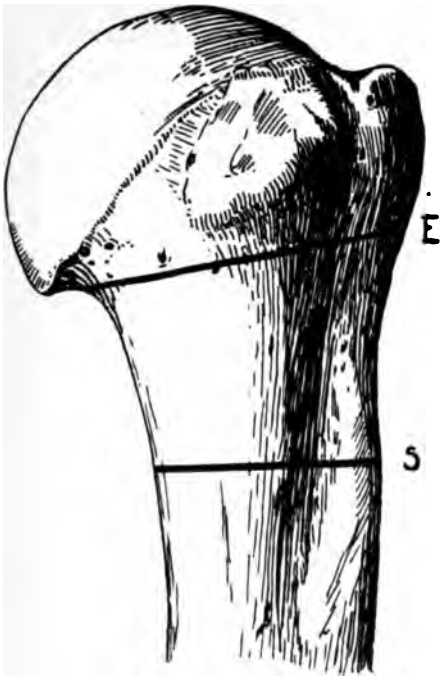


Fig. 347.—E. Anatomical neck.
S. Surgical neck.

Fig. 348.

the arm. This splint is supplemented by one having a shoulder cap, and properly molded to the shoulder, outside of the arm and extending to near the elbow. The splints are secured in position by proper turns of a roller bandage, and then the arm immobilized to the side of the chest, the forearm being supported in a sling at the wrist. The splints should be removed once a week or oftener if necessary, the arm examined, bathed, cleansed with alcohol and dusted with talcum powder, and the splints and bandages reapplied. About the end of the sixth week one or both splints may be left off and slight passive and active motion instituted. In cases in which the fractured surfaces cannot be properly adjusted in consequence of comminution or rotation of the upper fragment, they should be exposed by incision, adjusted and if thought best, wired together or removed. The removal of

the head and upper portion of the neck of the humerus leaves functionally a very good arm.

FRACTURE THROUGH THE SURGICAL NECK, INCLUDING SEPARATION OF THE UPPER EPIPHYSIS.

The surgical neck comprises that restricted portion of the humerus

Fig. 349.—Fracture just below the anatomical neck.

situated below the tuberosities, and above the insertion of the pectoralis major and latissimus dorsi. Separation of the epiphysis may occur at any

time before the twentieth year of age, and cannot be differentiated, insofar as location is concerned, from a fracture through the surgical neck.

Fig. 350.—Fracture of shaft of the humerus. X-ray tracing.

In cases in which the fracture is oblique and the tendency of the fractured surfaces to override is marked and cannot be overcome by the molded splints, extension may be applied to the elbow by hanging from it a bag of sand, or, if the patient is recumbent, making traction by a weight and pulley.

In fractures through the upper portion of the humerus, associated with dislocation of the head of the bone, an attempt should be made to reduce the dislocation by manipulation, and failing in this the head of the bone should be exposed by incision, when it may ordinarily be forced into position. If this is not possible by manipulation, a gimlet may be bored into the bone upon which traction may be made for the purpose of assisting in its reduction. After reduction the fractured surfaces are adjusted, and if thought best wired together. The wound is closed and proper dressings applied (Fig. 349).

SEPARATION OF THE EPIPHYSIS.

The line of the epiphysis commences internally just below the head of the bone, and extends squarely across the bone, so as to include the tuberosities. An epiphyseal separation may occur at any time before the twentieth year, and may be caused by direct or indirect violence.

Differential Diagnosis from Fractures of the Surgical Neck.—The patient is under twenty years of age; the crepitus is softer; the ends of the separated bone if they can be felt are smoother than in fractures; and the separation is squarely across the surface.

Treatment.—This is the same as for fractures of the surgical neck. A good result can usually be expected in epiphyseal separation.

FRACTURES OF THE SHAFT OF THE HUMERUS.

These may include all of those fractures which are situated below the upper fourth of the bone and two inches above the condyles. Fractures of the shaft of the humerus are caused by direct and indirect force. They are represented by the usual symptoms of fracture, that is, pain, swelling, functional disability, crepitus, deformity, and shortening. In determining shortening one should make measurements from the tip of the external condyle to the point of the acromion process, with the arm hanging by the side, and then compare these with the measurements of the uninjured arm.

Diagnosis.—The diagnosis is readily made by inspection and examination (Figs. 350 and 351).

Treatment.—The fracture can ordinarily be readily adjusted by extension, counter-extension, and manipulation. If the fracture is a transverse one there is likely to be but little displacement. In oblique fractures the displacement may be marked and the shortening considerable. Nonunion is also of frequent occurrence. This is probably due to incomplete adjustment and imperfect immobilization.

In the treatment of fractures of the shaft implicating the upper half of the bone, and after complete adjustment, the same dressing may be applied as in fractures of the surgical neck. In these cases the hand, forearm and elbow should be enveloped in sheet wadding, and then supported by a snugly fitting bandage, before the dressings for the fracture are applied. After the application of the dressings, the wrist and hand are supported by a sling.

Fig. 353.—Determining the relation of the condyles.

with wrist drop. If the paralysis persists after the union of the fracture, the nerve should be exposed, liberated from pressure, or if lacerated, united by suture, after excision of the bulbous ends. In oblique fractures of the lower third, with a line of fracture extending from behind downwards and forwards, the lower end of the upper fracture may pierce or make undue pressure upon the brachial vessels, leading to severe hemorrhage, aneurism, or gangrene of the forearm. In these cases it may be necessary to expose and double-ligate the vessel, or if gangrene occurs, amputate the arm.

FRACTURES OF THE LOWER END OF THE HUMERUS.

The recognition, proper adjustment and successful treatment of fractures at the elbow joint, represent one of the most difficult problems in this

Fig. 354.—Locating the condyles and olecranon process.

Fig. 355.—Locating the head of the radius.

branch of surgery. In order to thoroughly understand and correctly diagnose fractures about the elbow joint, one must have a clear conception of the bony landmarks and anatomy of the elbow.

METHOD OF EXAMINATION.—One should first inspect the two arms, note the presence or absence of deformity, recall the prominent points in the bony anatomy of the elbow joint, or carefully examine the uninjured member. When the arm is extended the two condyles and the top of the olecranon process are practically on the same line, the olecranon is usually

Fig. 356.—Seeking for lateral motion in the joint.

slightly higher than the condyles. In the extended position the elbow joint has no lateral motion, the internal condyle is large and prominent, the external condyle small and less marked. With pronation and supination of the forearm, the head of the radius can be readily felt to roll under the thumb directly below the external condyle. In examining an injured elbow joint, the patient should be anesthetized and then the surgeon should carefully locate and examine each one of the bony prominences. At first it will be well to determine if the two condyles and the top of the olecranon process are on the same line (Figs. 353 and 354). If they are not, then there must be either a fracture or dislocation. If they are on the same line a dislocation can be excluded, but a fracture without displacement may still be present. After noting the relations of the bony prominences, each should be examined separately.

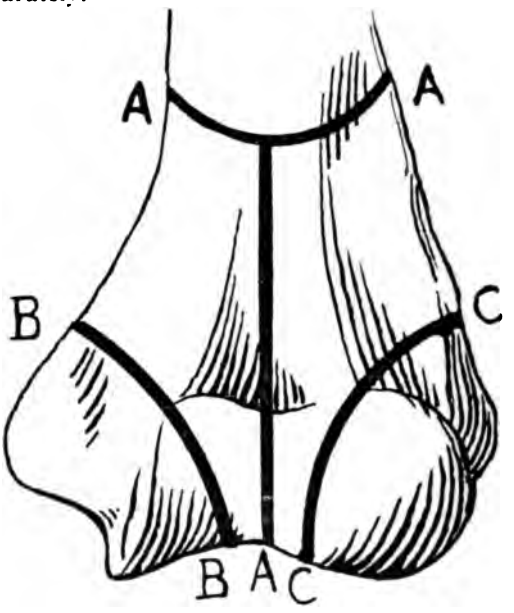


Fig. 357.—Diagramatic. A. A. Fracture of lower end of humerus. A. A. A. T-shaped fracture. B. B. Fracture of internal condyle. C. C. Fracture of external condyle.

The surgeon fixes the arm with one hand and grasps the internal condyle between the thumb and two or three fingers of the other hand and makes forcible efforts to move it. If the condyle is fractured off it can readily be moved, and these movements will be attended with crepitus. Then the external condyle is similarly examined, and then the olecranon process, and head of the radius. During these manipulations, pronation, supination flexion and extension of the forearm are practised (Figs. 355 and 356).

FRACTURES OF THE EXTERNAL CONDYLE.

These may be produced by direct or indirect violence. In falls upon the outstretched hand the force is transmitted along the radius to the external condyle, which may be fractured off and displaced. The displace-

ment, if any occurs, is usually upwards, and not very pronounced. If the force is continued after the fracture of the external condyle, dislocation backwards of the ulna is likely to occur. Fracture of the condyle may also be caused by falls or blows received directly over the process.

SYMPTOMS.—The arm falls somewhat to the radial side, the carrying angle being slightly increased. The relation of the three bony prominences is usually slightly altered. There is localized tenderness, swelling, pain and crepitation on motion. The examination should not be considered complete until the internal condyle, the olecranon process of the ulna and the head of the radius are carefully examined. If there is much swelling it may be difficult to outline a condyle, but by steady, firm pressure this can ordinarily be accomplished. Under ordinary conditions the greatest swelling, ten-

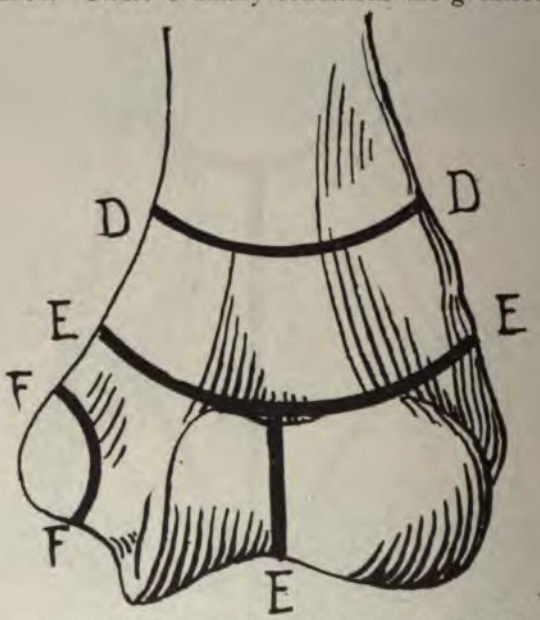


Fig. 358.—Diagramatic. F. F. Fracture of internal epicondyle. D. D. Supra-condyloid fracture. E. E. E. T-shaped fracture through and between the condyles.

derness and ecchymosis overlie the seat of greatest injury (Fig. 357).

The prognosis is usually good.

FRACTURE OF THE INTERNAL EPICONDYLE.

This fracture may occur at any time before the seventeenth or twentieth year. If the portion broken off is small, the fracture is of no great consequence. A compress may be applied over the epicondyle and held in place by a bandage, and the elbow immobilized for two or three weeks at a right angle (Fig. 358).

FRACTURE OF THE INTERNAL CONDYLE.

This accident is usually caused by a fall directly upon the internal surface of the elbow joint (Fig. 359).

SYMPTOMS.—There is loss of function, pain, swelling and crepit 'he normal relationship of the three bony prominences is changed, the

Fig. 359.—Fracture of internal condyle.

ternal condyle being, as a rule, displaced slightly upwards. The carryi angle of the arm will usually have disappeared. The forearm is ordinar pronated and lateral motion, and especially adduction, possible. If the

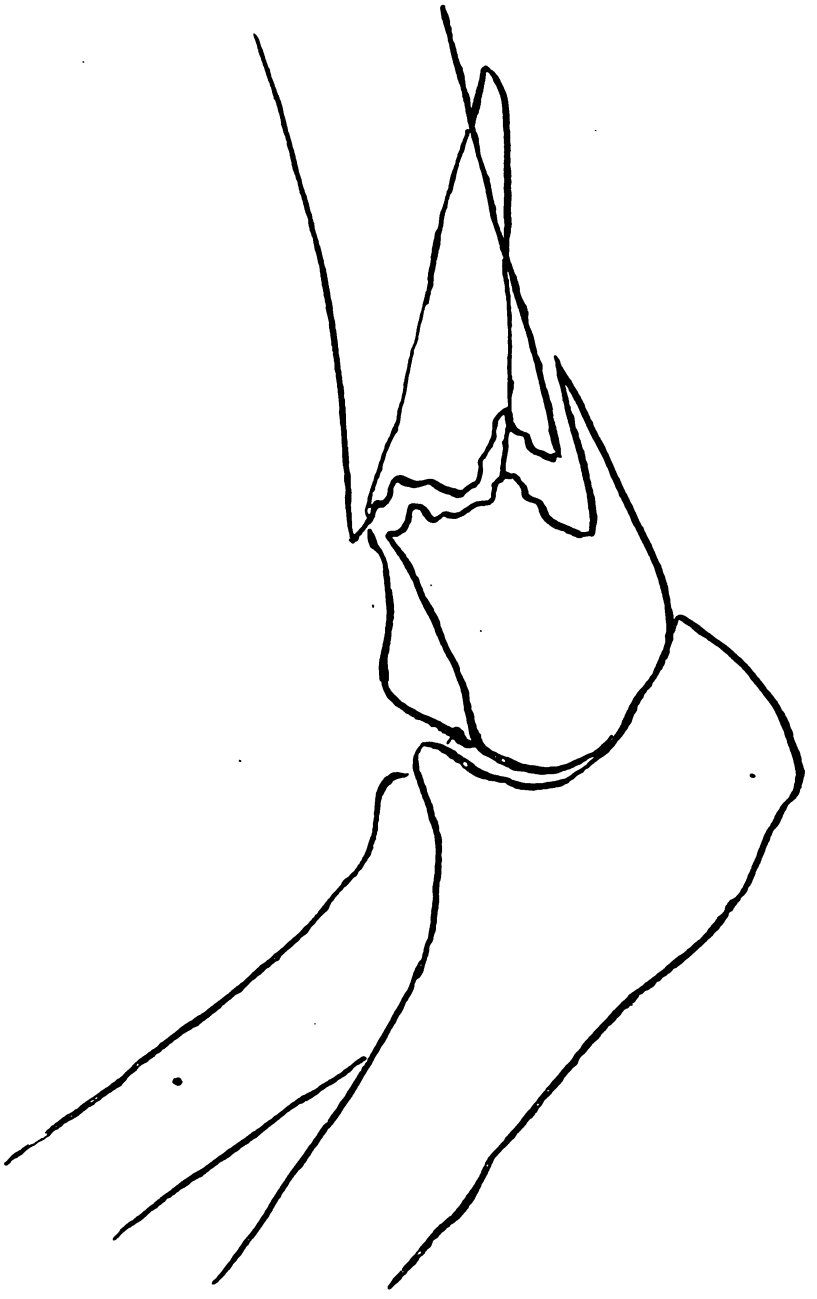


Fig. 360.—Fracture of humerus above the condyles. X-ray tracing. Adult.

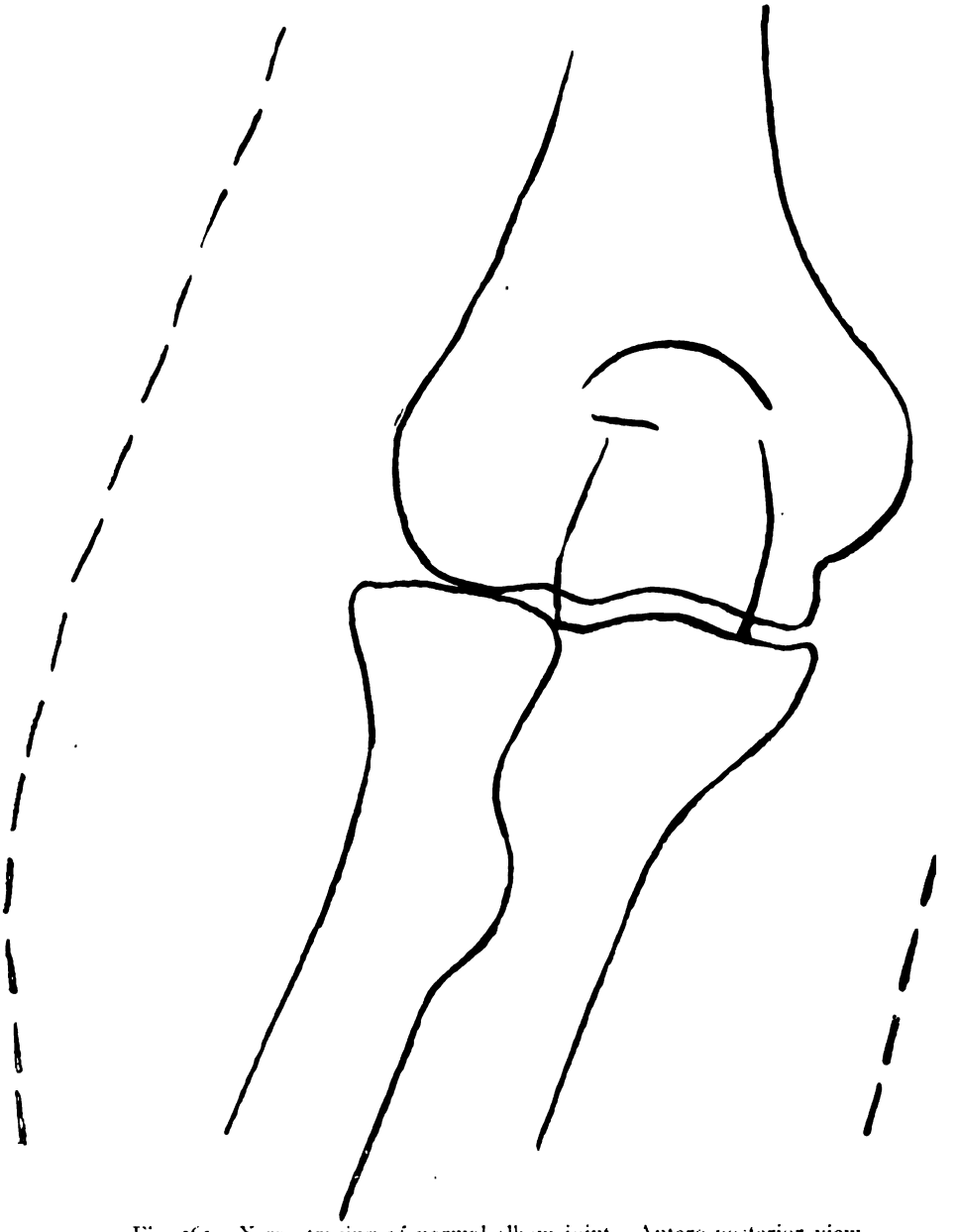


Fig. 361.—X-ray tracing of normal elbow joint. Antero-posterior view.

ternal condyle is grasped between the thumb and fingers it will be found movable upon the shaft, and this motion will be attended with crepitation.

PROGNOSIS.—This is usually good in uncomplicated cases. If the condyle is not retained in position, or if immobilization is not perfect, a large

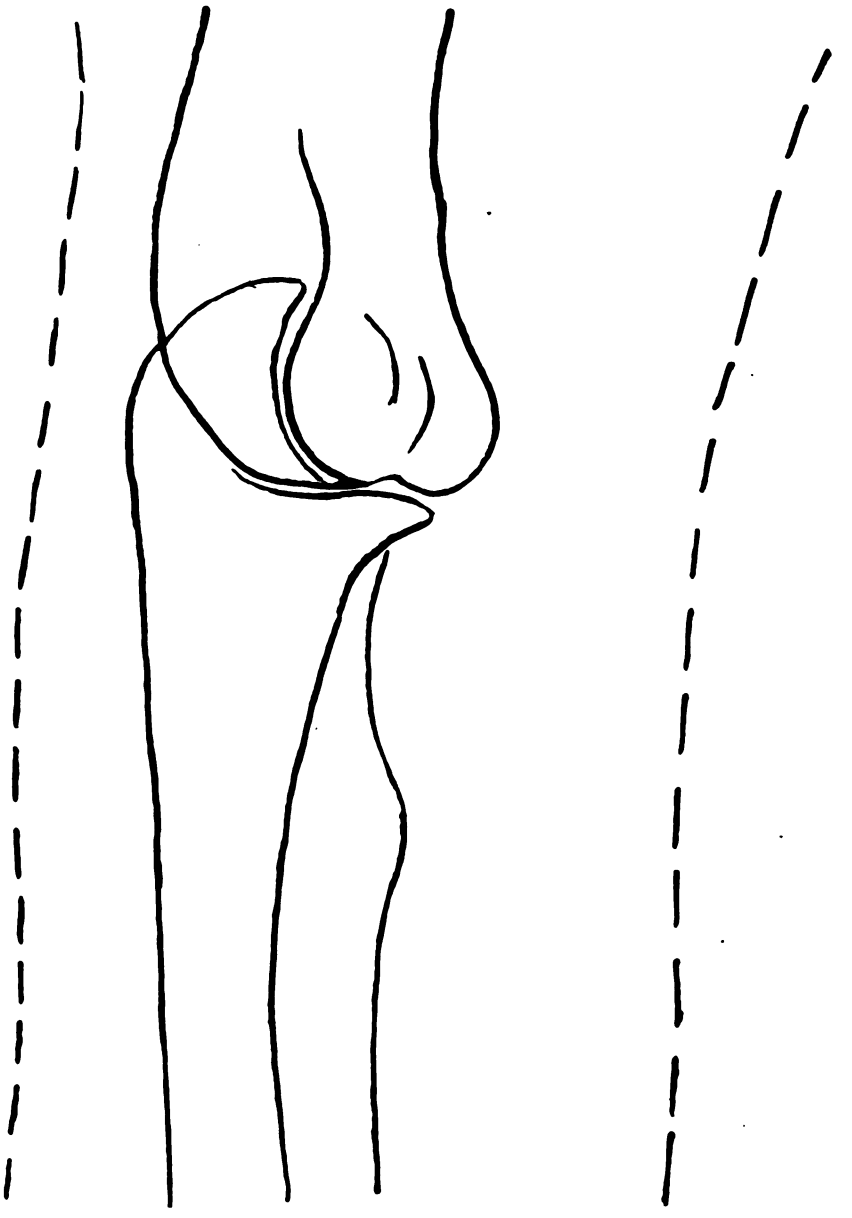


Fig. 362.—X-ray tracing of normal elbow joint. Lateral view.

callus is likely to be thrown out, causing restriction of motion and possibly ankylosis.

TRANSVERSE FRACTURE OF THE SHAFT OF THE HUMERUS ABOVE THE CONDYLES.

This fracture occurs most frequently in children. It may be caused by direct or indirect violence. The lower fragment is displaced backwards and upwards (Fig. 360).

SYMPTOMS.—There is pain, swelling, shortening, loss of function, and crepitation on motion.

The tip of the olecranon is prominent posteriorly, and all three of the bony prominences are on a line. The condyles cannot be moved upon each other, but together are movable from the shaft. If the arm is fixed with one hand and extension made from the forearm with the other, crepitus will be experienced and the deformity will be corrected. If the extension is relaxed the deformity usually recurs.

DIAGNOSIS.—The diagnosis is especially based upon the facts that the condyles are inseparably connected and in normal relations with the bones of the forearm, and that there is motion between the condyles and shaft, attended with crepitus. Especially in fractures in and about the elbow joint, any uncertainty should be relieved by the use of the X-ray (Figs 361 and 362).

PROGNOSIS.—This is good if proper reduction and immobilization are secured.

SEPARATION OF THE LOWER EPIPHYSIS OF THE HUMERUS.

This may occur at any time before the sixteenth year. The lower epiphysis includes the external epicondyle and the articulating surfaces of the bone. The separation occurs quite frequently in children under twelve years of age. The internal condyle forms a separate epiphysis, which unites with the shaft at about the eighteenth year. Separation of both of the epiphyses may occur at the same time.

The symptoms will not differ materially from those of transverse fracture close above the condyles.

The diagnosis will rest upon the age of the patient, the soft character of the crepitus and the situation of the fracture low down near the joint, and the possibility of the separation not including the internal condyle.

T-SHAPED FRACTURES INTO THE ELBOW JOINT.

These are of frequent occurrence in children and young adults. The fracture is usually caused by a fall upon the hand or elbow. The injury is ordinarily followed by great swelling, making it difficult to outline the seat and extent of the fracture. There is marked deformity with excessive lateral and antero-posterior motion.

The diagnosis must be based upon the fact that there is motion between the condyles and between the condyles and shaft of the humerus, with crepitus, and that the normal relationship between those bony points is changed.

PROGNOSIS.—This is, as a rule, unfavorable insofar as a perfect result is concerned. Union readily occurs, but the calus and inflammatory exudate are at times so considerable as to materially restrict the movements of the joint.

Treatment of Fractures of the Lower End of the Humerus.—The patient should be anesthetized and after reduction by extension, counter-extension and manipulation, the arm is placed in that position which most perfectly holds the fractured surfaces in position. This may be com-

Fig. 363.—Swath for maintaining arm in acute flexion.

plete extension, at a right angle, or in the position of acute flexion. Experience has shown that in the position of acute flexion the coronoid process in front, the olecranon and triceps behind, and the fascia on the sides,

maintain the fragments firmly in position. In placing the arm in the position of acute flexion the condyles are grasped with the left hand, while traction is made upon the forearm with the right hand. The fragments are manipulated into position as the joint is acutely flexed. The approximated surfaces of the skin at the elbow should be protected from excoriation by talcum powder, and a folded piece of gauze. The approximating sur-

Fig. 364.—Arm fixed in acute flexion by swath.

faces between the hand, forearm and chest-wall, should be similarly protected. The arm may be held in the position of acute flexion by a modified Velpeau's bandage, or by a wide strip of adhesive plaster encircling the arm near the axilla and the forearm just above the wrist; or the arm may be supported by a figure-of-eight swath (Figs. 363 and 364).

To make the swath, take a piece of firm cheese-cloth of sufficient length to pass twice around the body, and fold it twice lengthwise. One end of the middle third is then placed beneath the forearm, the short end carried beneath the arm, and then across the arm in front of the chest. The long end envelopes the forearm and is carried over the corresponding shoulder, across the back, down beneath the opposite axilla and across the chest, it is drawn taut and the two ends united by several safety pins, or knotted. One or two safety pins may unite that portion of the swath which passes over the arm with that portion which passes across the chest, and if it is drawn reasonably snug this will not only hold the elbow firmly against

Fig. 365.—Arm held in position of acute flexion by adhesive plaster.

the side of the chest but hold the arm in its acutely flexed position (Fig. 364).

In putting the arm up in the position of acute flexion care must be taken, especially if there is much swelling, not to make undue pressure upon the vessels at the bend of the elbow. If the radial pulse is weak, or disappears, or the hand becomes swollen, the acuteness of the angle should be diminished until the swelling has disappeared. The bandages should be removed at the end of each week in order to examine the seat of the fracture and cleanse the parts, when the bandages may be renewed. In some cases the fragments come perfectly in position when the forearm

is at a right angle. In these the arm should be dressed in this positic and supported either with a posterior or anterior right-angled splint (Fi 365). In exceptional cases the fragments can only be retained in tl position of complete extension. In these cases the arm may be dresse with a long anterior splint and maintained in this position for three week when flexion is gradually undertaken. In every case of fra ture into the elbow joint the friends should be apprised of the seriousne of the condition and of the possibility of a stiff joint. When the arm

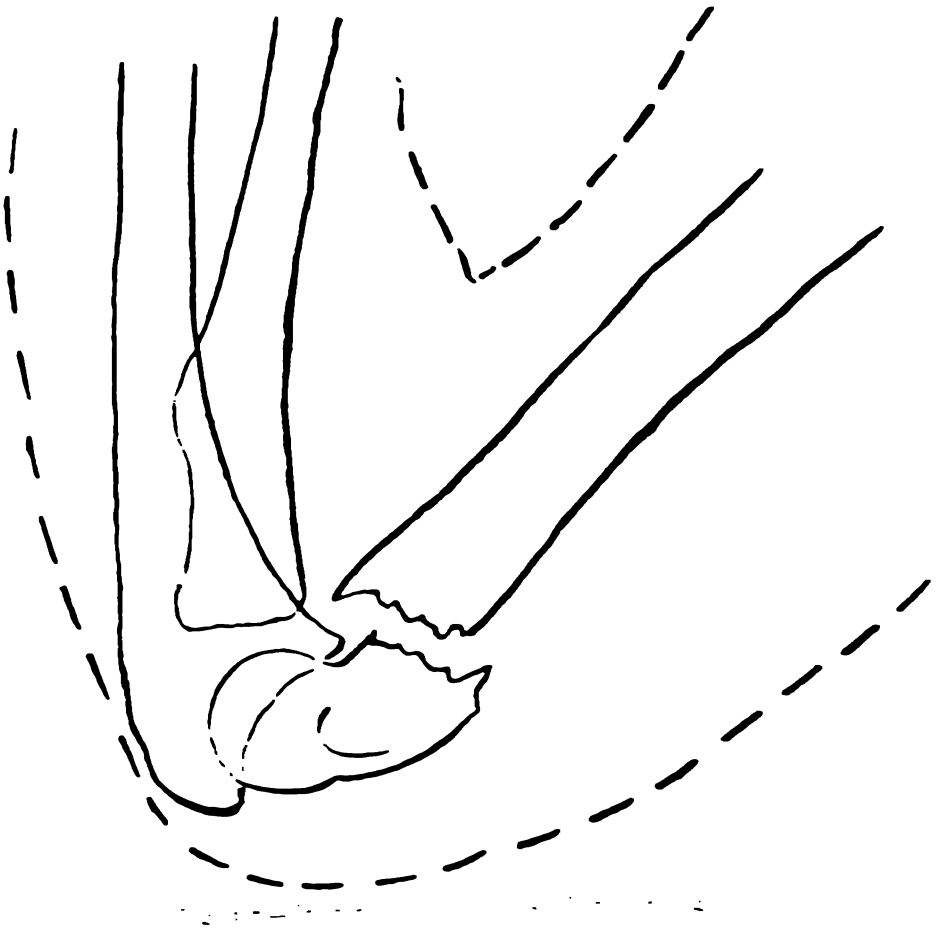
Fig. 366.—Internal right-angle splint.

dressed in the extended or right-angled position, the resulting limitatic of motion is usually one of flexion, and there is often difficulty in ove coming it. In one of my cases where the prevention of flexion was dı to an excessive callus in a T-shaped fracture, I exposed and trimmed aw: the callus with a perfect result.

In dressing an arm in the acutely flexed position, complete flexion usually retained. The limitation of motion is one of extension, and th can ordinarily be readily overcome by encouraging the patient to car

chairs, books, sandbags, dumbbells, or other articles, in the hand. Loss of extension in these cases is much more readily overcome than loss of flexion. After the removal of the splints it is usually advisable to bandage the arm for a few days, at the same time practising passive and active motion and massage.

PROGNOSIS.—Deformity may occur with more or less ankylosis. Under ordinary conditions, however, with the forearm acutely flexed, marked deformity is avoided, while the functional result is usually good (Figs. 366 and 367).



FRACTURE OF THE BONES OF THE FOREARM—FRACTURE OF THE OLECRANON

The brachialis anticus muscle is attached [illegible] the base [illegible] [illegible] the upper and [illegible] surface of the olecranon surface and into the adjacent fascia. The [illegible] of the olecranon to which the triceps is [illegible] [illegible] the upper

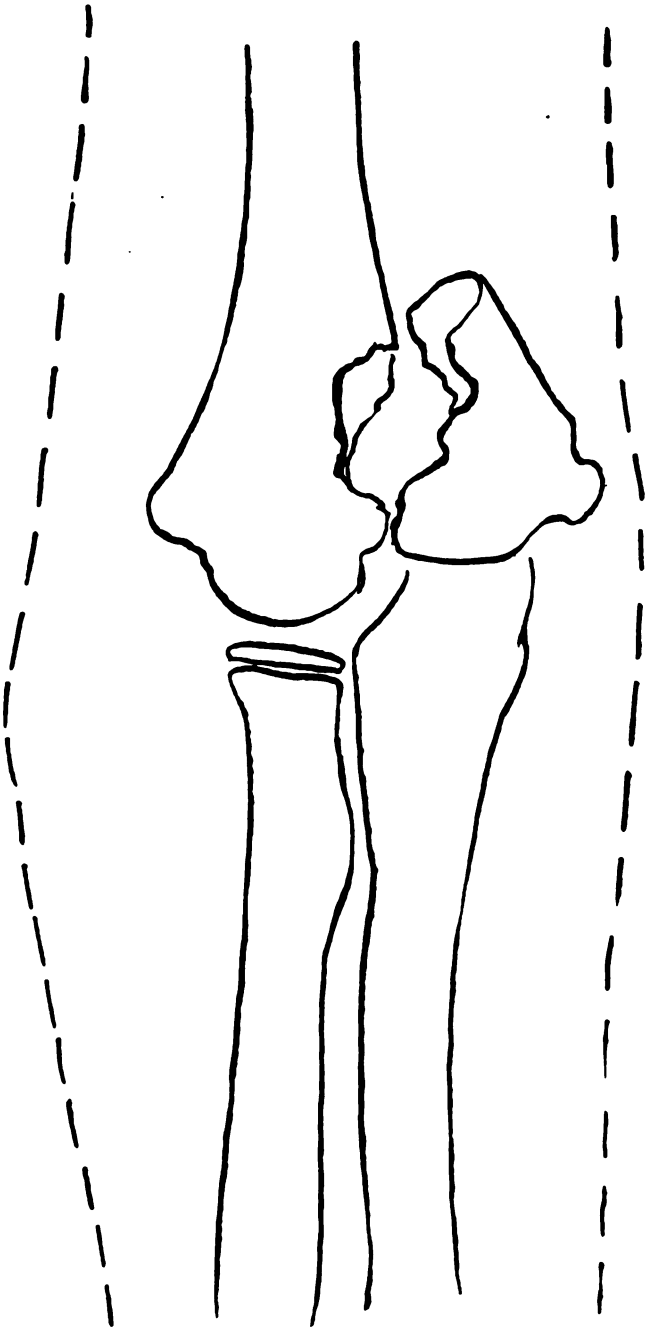


Fig. 368.—Internal condyle broken off. X-ray tracin

epiphysis and becomes united to the shaft at about the sixteenth year. Fractures of the olecranon are usually caused by direct force or muscular action and are most frequently situated at the restricted portion of the

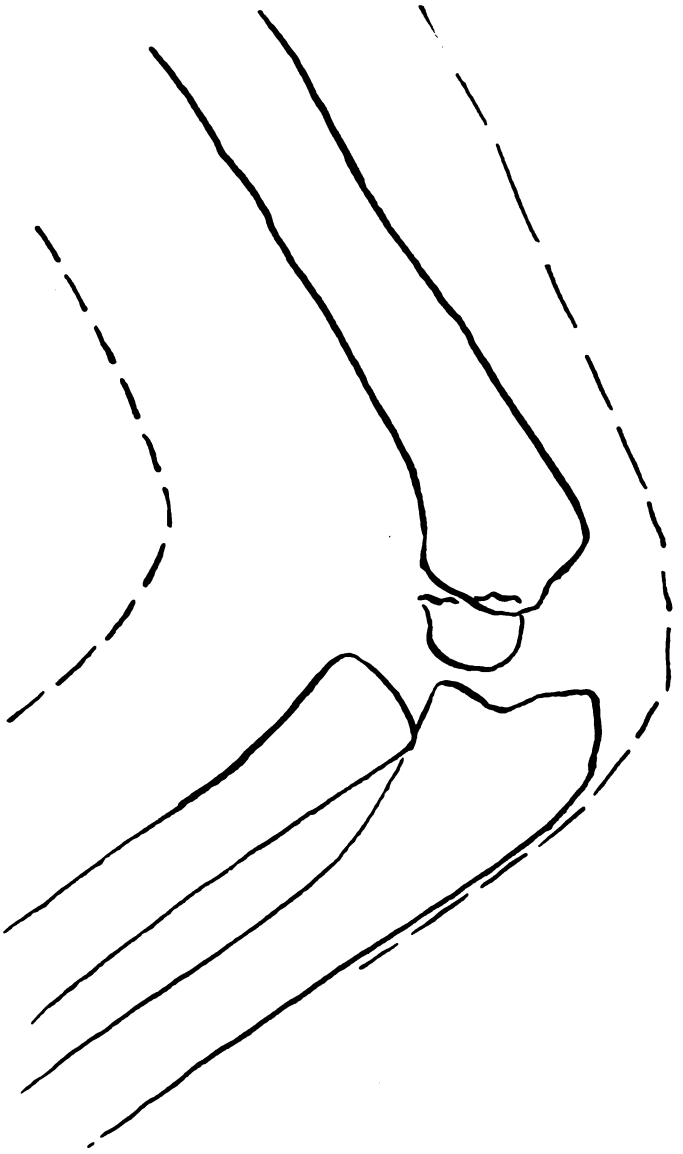


Fig. 369.—Fracture of the olecranon. X-ray tracing.

base. The fracture is usually transverse, or the olecranon may be comminuted. A complete fracture of the olecranon opens the elbow joint (Figs. 368 and 369).

SYMPTOMS.—The patient cannot extend the forearm, there is also localized pain and swelling. On grasping the olecranon motion can be elicited, and this will be attended with crepitus if the fragments are in contact. An interval between the fragments can usually be made out. This interval is likely to be greater if the forearm has been forcibly flexed. In epiphyseal separations and in some cases of fracture, only a thin shell

Fig. 370.—Dressing for fracture of the olecranon.

of bone is torn off at the site of the attachment of the triceps. This condition might readily be overlooked if the examination was confined to the base of the olecranon.

TREATMENT.—For the purpose of relaxing the triceps muscle the arm is placed in the extended position; a long splint reaching from the axilla

bandages are properly applied. During the third week the bandages may be removed and the elbow joint slightly flexed, the olecranon being supported during this maneuvre. The arm is then brought into the straight position and the dressing reapplied for another week, when the splints usually may be left off and the arm supported only by a bandage. Passive and active motion with massage are then instituted. In cases in which the fragments cannot be approximated, they should be exposed by a short longitudinal incision, the blood clots turned out, and the fractured surfaces, if necessary, smoothed off and then brought together by wire suture or chromicized catgut. Following this the arm is put up in the extended position. Murphy has successfully practised subcutaneous extra-articular suture for the retention of the fragment in this class of cases. The advantage of the method is that the joint is not opened.

FRACTURE OF THE CORONOID PROCESS OF THE ULNA.

This accident is rare, but may occur in backward dislocations of the ulna. The fragment broken off is usually small, and the displacement slight. If in the backward dislocation of the ulna recurrence takes place after reduction, fracture of the coronoid process should be suspected. The small piece may in exceptional cases be felt just above the fold of the elbow. The Roentgen ray will clear up the diagnosis.

TREATMENT.—In the treatment a compress should be placed over the fracture and the arm secured in a right-angled splint for four weeks, the forearm being supported by a sling about the neck.

FRACTURE OF THE HEAD AND NECK OF THE RADIUS.

This fracture is of extremely rare occurrence. It may, however, take place in severe injuries to the elbow joint, especially when associated with fractures of the external condyle, coranoid process or with dislocations of the elbow.

SYMPTOMS.—The head and neck of the radius are painful on pressure. Pressure upon the shaft of the radius also causes pain. The rotation of the forearm is painful and may be attended with crepitus. If there is complete fracture of the neck the head of the bone will not rotate under the thumb when the forearm is pronated and supinated. The X-ray should be used if possible in establishing the diagnosis.

TREATMENT.—The parts are manipulated into position and if there are no associated injuries the arm should be dressed in the flexed position midway between pronation and supination, so as to relax the biceps, and preserve, if possible, the rotation of the forearm. The forearm, as in nearly all fractures of the arm or forearm, should be supported in a broad sling carried about the neck.

INCOMPLETE OR GREENSTICK FRACTURES OF THE BONES OF THE FOREARM.

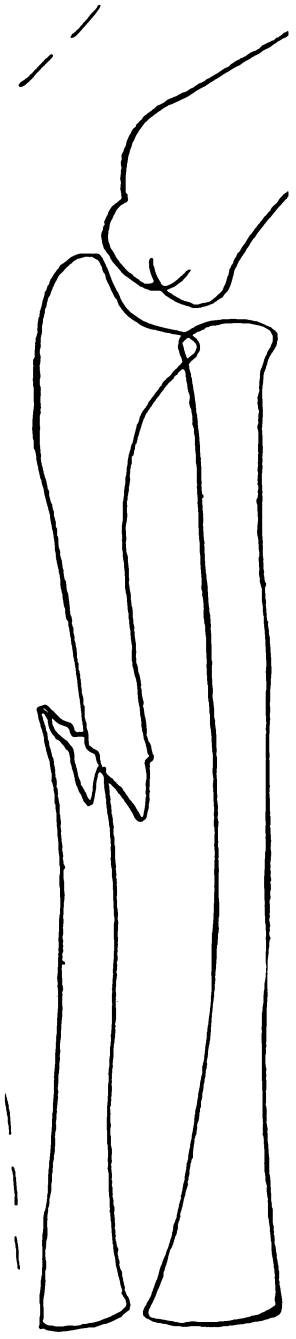
These fractures are very frequent in childhood. They may be the result of direct or indirect force. One or both bones may be broken. As a rule the bones are only partially broken across, the remaining portion being markedly bent. The deformity is usually pronounced and the limb fixed

in its abnormal position. There is neither crepitus nor preternatural mobility (Fig. 371).

The diagnosis is readily established in consequence of the age of the patient, the deformity, fixed position, and absence of crepitus.

Fig. 373.—Dressing for the forearm with thumb up.

TREATMENT.—An anesthetic is ordinarily not necessary. In the adjustment of the fracture the forearm is grasped by the surgeon's hands, one being placed on each side of the fracture. The bones are then forced back into position by bending the fractured area over the surgeon's knee.



Fracture of shaft of the ul

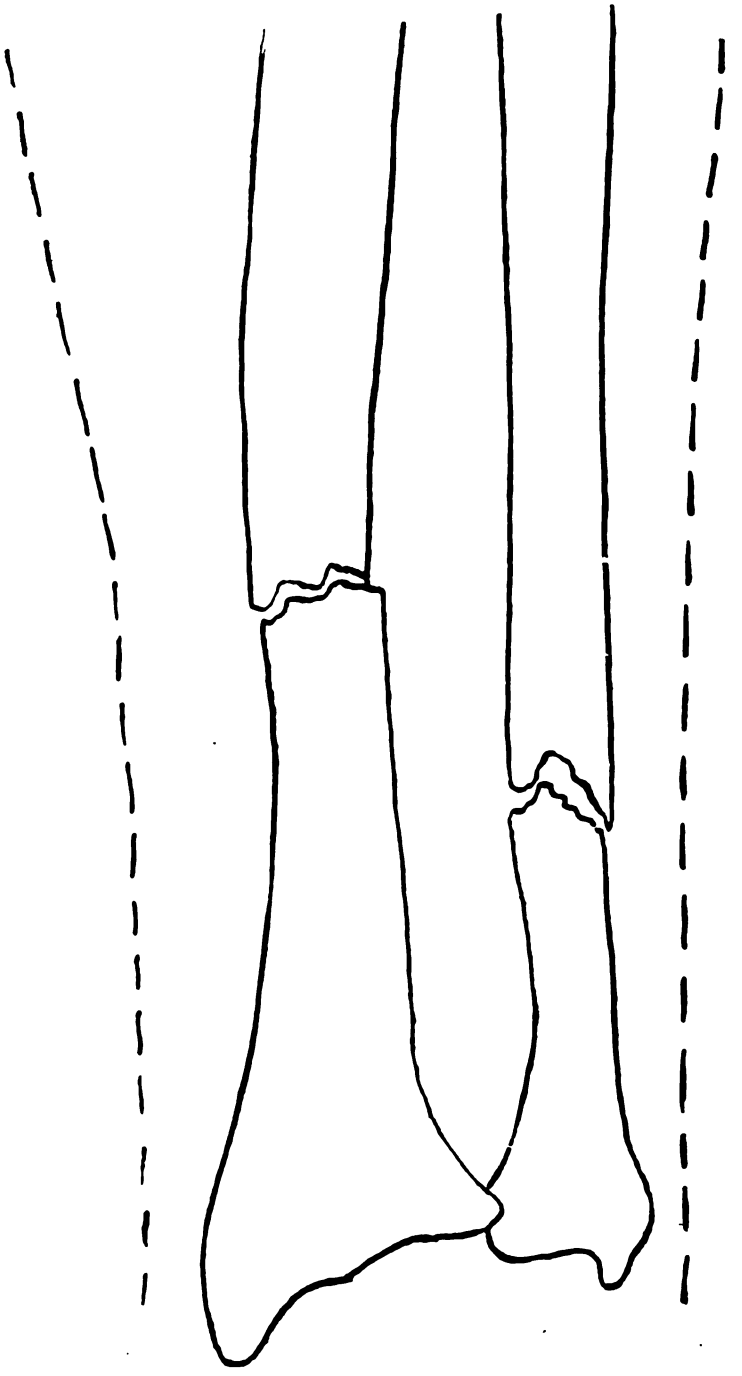


Fig. 375.—Fracture of both bones of the forearm. X-ray tracing.

Care should be taken that the deformity is fully corrected. Well padded, lateral splints should then be applied and retained for two or three weeks,

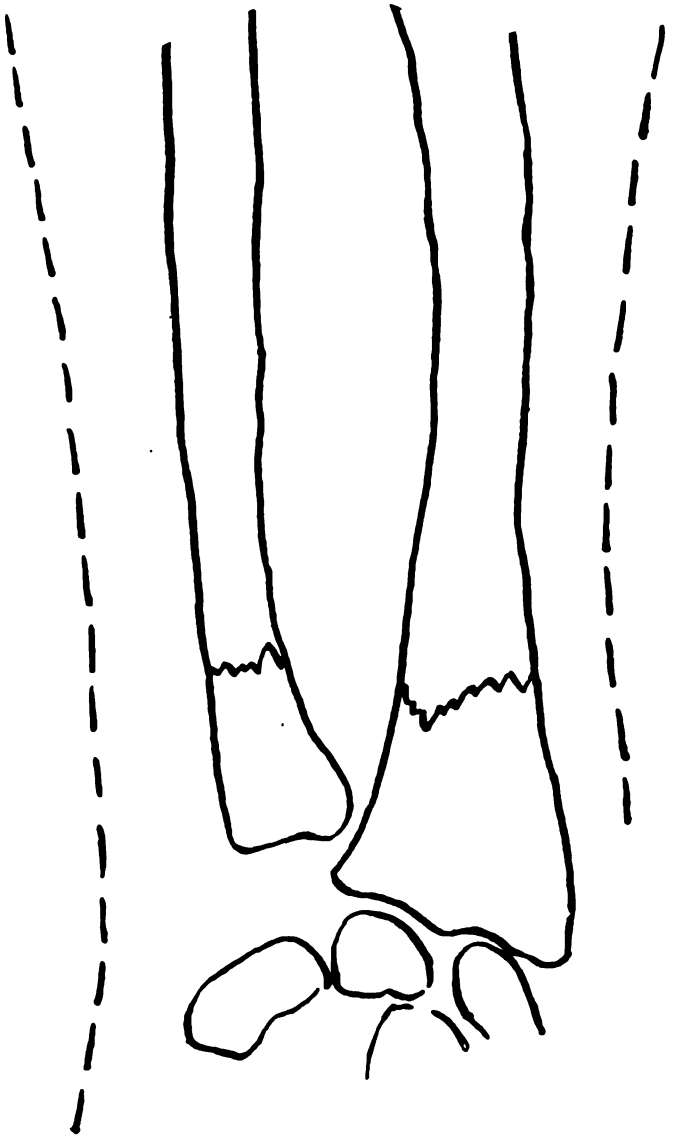


Fig. 376.—Fracture of both bones of the fore arm, antero-posterior view. X-ray tracing.

and the forearm carried in a sling. The tendency to displacement in these cases is very slight.

FRACTURES OF THE SHAFT OF THE RADIUS.

The radius is frequently broken as the result of direct force applied to the bone, or indirect force, as from a fall upon the hand. There will be the usual symptoms, pain, swelling, local tenderness, crepitation and deformity. Lateral displacement from the force of the blow or from the pressure of dressings may occur. In a fracture situated above the insertion of the pronator radii teres, or above the middle of the shaft, the upper fragments is supinated by the unopposed action of the biceps, while the lower fragment is usually pronated. This position necessitates that the hand during the healing process be placed in a position of supination, so that pronation will not be lost after union has occurred (Fig. 372).

The diagnosis of fractures of the shaft is usually readily made in consequence of the superficial position of the bone. Union is usually complete in from four to six weeks.

TREATMENT.—(In fractures situated below the middle of the shaft.) After reduction by extension, counter-extension and manipulation, the arm should be held in a position midway between supination and pronation, that is with the "thumb up" and supported by two well-padded lateral splints which are one-half inch wider than the arm. This is for the purpose of protecting the limb from perpendicular pressure by the bandage. The dorsal splint should extend from just below the external condyle to the metacarpo-phalangeal joints and the palmar splints from the bend of the elbow to the base of the metacarpal bones (Fig. 373).

FRACTURE OF THE SHAFT OF THE ULNA.

This fracture is of more frequent occurrence than is fracture of the shaft of the radius and is usually produced by direct force, as a blow upon the outer surface of the arm. The displacement is usually not marked, in consequence of the radius acting as a splint. The fracture may be complicated by dislocation at the elbow (Fig. 374).

The symptoms will be represented by pain, local tenderness and swelling and some deformity. If the ulna is grasped above and below the seat of fracture, and pressure made upon it, crepitus will likely be elicited.

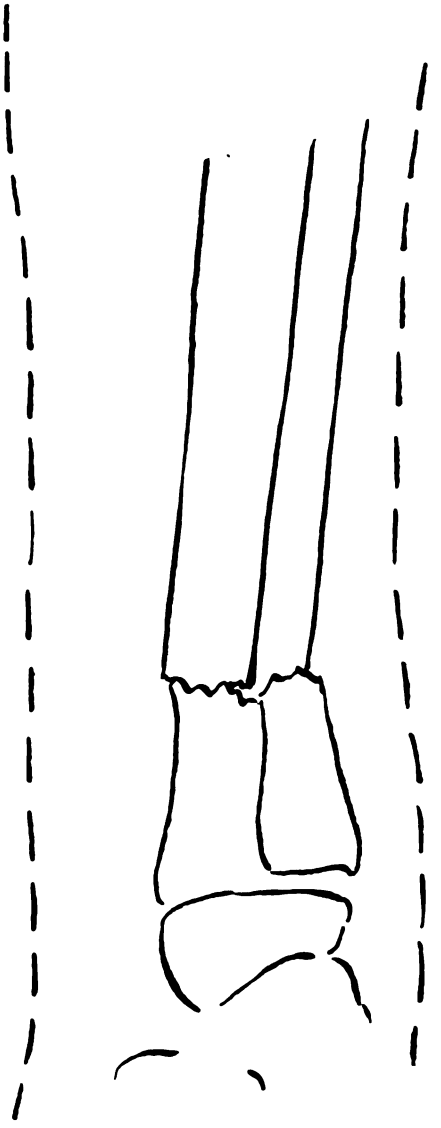
The treatment should consist in the application of lateral splints, the same as for fracture of the shaft of the radius, or by the application of a plaster of Paris cast.

FRACTURE OF BOTH BONES OF THE FOREARM.

This fracture may occur from direct or indirect violence, but is more often produced by direct force. The fracture is most frequently situated in the middle of the lower third. The line of fracture may be transverse or oblique. The bones may be broken on the same plane, or the ulna may be broken on a plane slightly higher than the radius. The displacement may be transverse, angular or through overriding. The upper fragments are usually drawn together or pronated, while the lower fragment of the radius is often supinated in consequence of the action of the supinator longus (Figs. 375 and 376).

The diagnosis is readily made on account of the marked deformity, crepitus and free mobility.

should ordinarily be anesthetized and then the displacement
ision, counter-extension and manipulation. The surgeon
areful that the fracture is fully reduced and that the inter-
not encroached upon. Otherwise rotation will be limited or



are of both bones of the forearm, lateral view. X-ray tracing.

d. After reduction the forearm may be placed in the
supination and supported by a long posterior splint ex-
e elbow to the tips of the fingers, and by a right-angled

keeping the arm in full supination, than it is in the position midway between pronation and supination. In the application of a plaster of Paris cast to the arm and forearm, the parts should first be enveloped in sheet wadding, which is supported by a loosely applied gauze bandage. Three or four plaster of Paris bandages, each three inches wide and four yards long, will usually be required in making the proper cast. The bandages are evenly and snugly applied, while the arm is securely held in position by an assistant, and the reduction maintained. As the plaster is setting, lateral pressure may be made at the site of the fracture and on each side

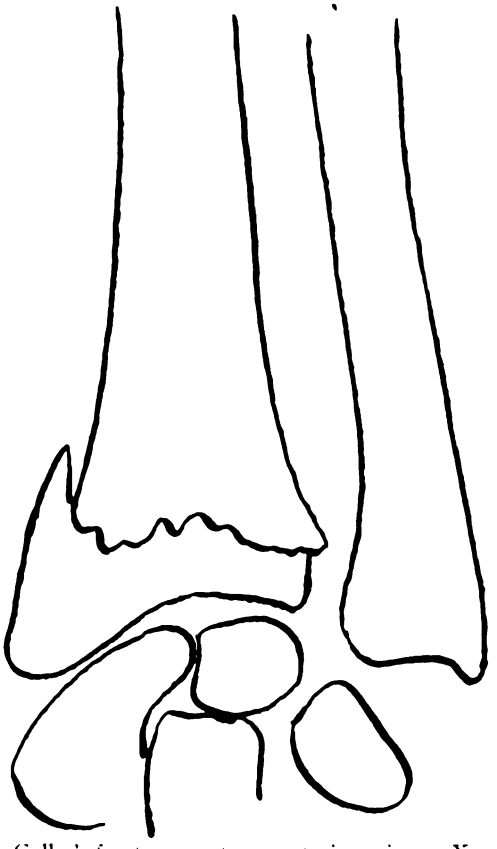


Fig. 379.—Colles' fracture—antero-posterior view. X-ray tracing.

of the arm, for the purpose of maintaining as wide an interosseous space as possible. The cast should be inspected daily for two or three days to see that it is not too tight. The cast or splints that cause pain, numbness, throbbing in a part, or blueness of the finger tips, are too tight, and should be removed and reapplied. At the end of a week the cast will under ordinary conditions be too loose, and should be removed, the arm inspected and cleansed by washing it with soap and water and then with alcohol, and then dusting it with a powder composed of oxide of zinc and

starch, each equal parts, when the same case may be reapplied, if it is suitable, after additional padding, or a new cast may be applied (Fig. 377).

SEPARATION OF THE LOWER RADIAL EPIPHYSIS.

The lower epiphysis unites with the shaft from the twentieth to the twenty-fifth year. Separation is usually produced by a fall upon the

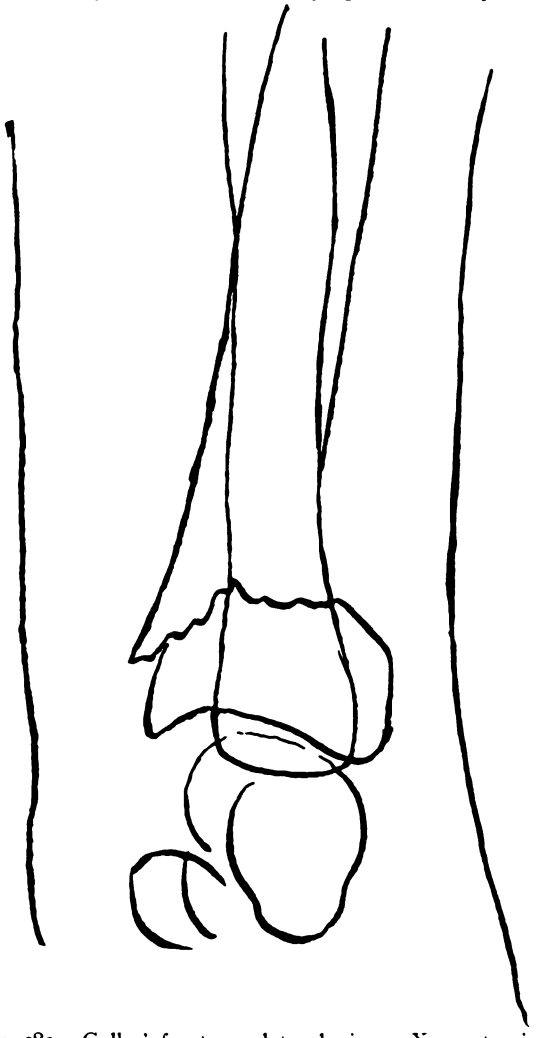


Fig. 380.—Colles' fracture—lateral view. X-ray tracing.

outstretched hand, and simulates a Colles' fracture. It differs from a Colles' fracture in not including so much of the head of the radius, also in being situated nearer the joint, in having a softer crepitus and occurring usually before the twentieth year. The treatment is the same as that hereafter described for Colles' fracture.

The growth of the radius takes place almost entirely from the lower epiphysis, and this may be arrested in consequence of an epiphyseal separation. In these cases the ulna continuing to grow, would push the hand over to the radial side, producing marked deformity.

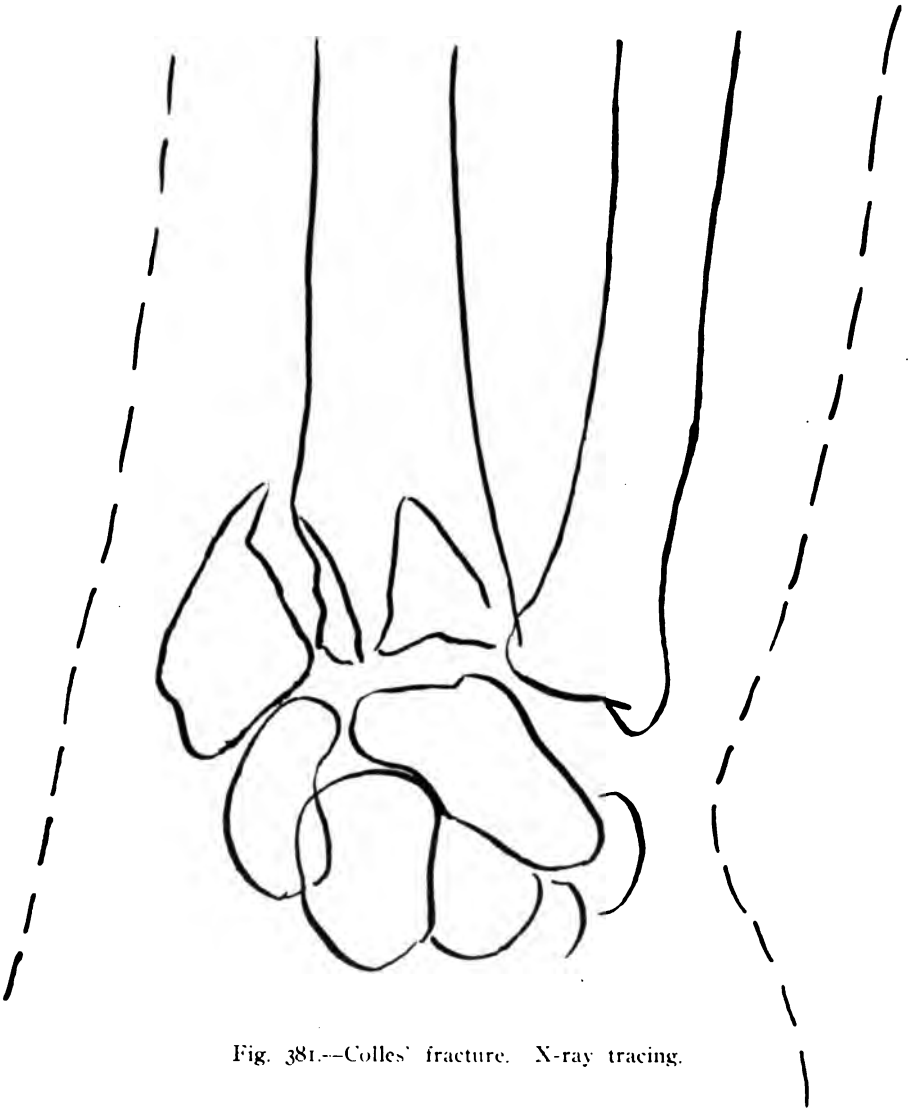


Fig. 381.—Colles' fracture. X-ray tracing.

FRACTURE OF THE LOWER END OF THE RADIUS—COLLES' FRACTURE.

This fracture is of frequent occurrence. It is more often seen in women than in men, but occurs in both sexes and at all ages. The fracture is usually caused by a fall upon the outstretched arm while the hand is extended and pronated. The fracture is often transverse, and situated

about one inch above the articulating extremity of the bone. The fracture may be oblique and extend from behind downwards and forwards. The head of the bone may be split perpendicularly, or more or less comminuted (Figs. 378, 379, 380, 381 and 382).

The lower fragment is carried upwards and backwards and is usually

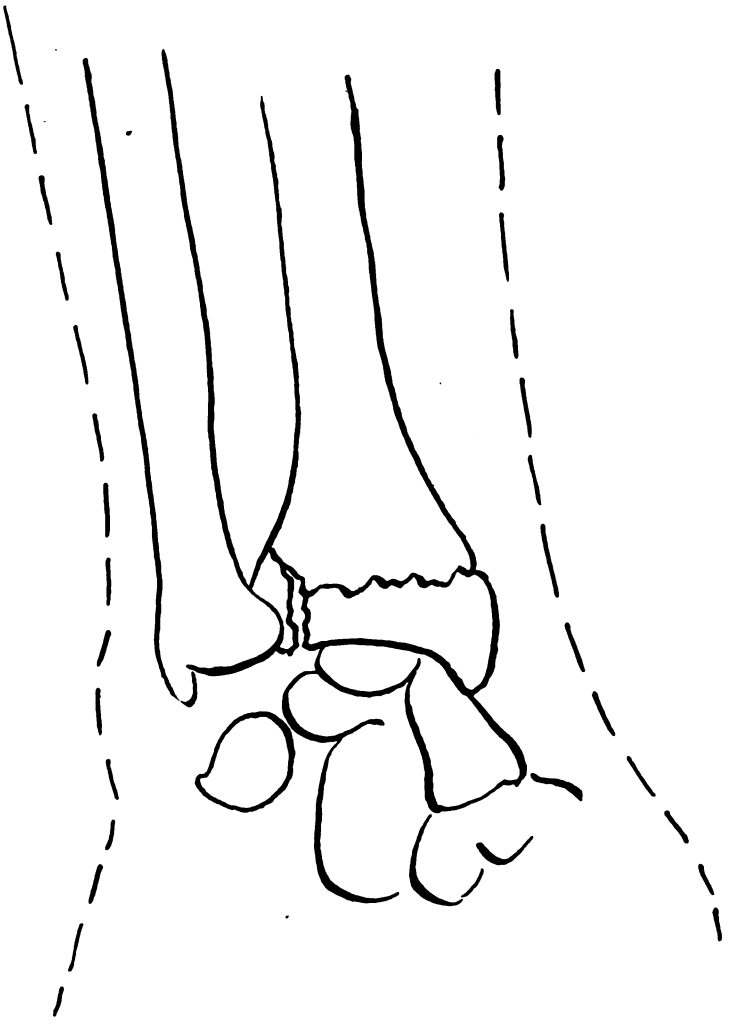


Fig. 382.—Colles' fracture. X-ray tracing.

impacted in the upper fragment, often with some destruction of its cancellated structure. In consequence of the support which the inner surface of the lower fragment receives from the radio-ulnar ligament, the outer side of the lower fragment is displaced more than the inner.

The deformity is characteristic. The lower fragment projects posteriorly, the lower end of the upper fragment anteriorly, producing the "silver fork" deformity (Fig. 383).

Lateral displacement: The hand and carpus follow the lower fragment, and become displaced to the radial side in consequence of the loss of radial support. The lower end of the ulna becomes prominent on the palmar surface of the wrist. The styloid process of the ulna is normally higher than that of the radius, following Colles' fracture it is usually lower.

COMPLICATIONS.—In fifty per cent. of the cases the styloid process on the ulna is torn off. The radio-ulnar ligament is frequently ruptured. The articular triangular fibro-cartilage is often torn. The end of the ulna occasionally perforates the skin.

DIFFERENTIAL DIAGNOSIS.—Colles' fracture should be differentiated from sprains of the wrist in which the deformity is due to effusion into the synovial membrane and situated over the carpus, the bones being in position; and from backward dislocation, of the carpus. In dislocations the carpal bones can be felt posteriorly, while the head of the radius is anterior and intact. The injury is lower down than in case of fracture, and following reduction in the case of dislocation, deformity does not occur.

TREATMENT.—In the majority of cases, in fracture of the lower end of the radius, the lower fragment is not only broken but it is driven upwards and into the lower end of the upper fragment. In other words, there

Fig. 383.—Silver-fork deformity.

is impaction. In order to get a good result and prevent deformity this impaction, if it is present, must be broken up, and the bones perfectly reduced. The patient should be anesthetized, and if the fracture implicates the left radius the surgeon grasps this hand with his own left hand, and the forearm just above the seat of fracture with his right, placing the thumb of the right hand just below the seat of fracture. The patient's hand with the lower fragment is then carried forcibly backward, if necessary almost to a right angle, or until the lower fragment is fully relieved from the upper. The hand should then be carried forward and extension made while the fingers of the right hand control the upper fragment and the thumb pushes the lower fragment into position. If the fracture is fully and perfectly reduced there is but little tendency towards displacement.

In the treatment a small compress of absorbent gauze should be placed posteriorly over the lower fragment, and a similar compress placed anteriorly over the lower end of the upper fragment. The arm may be dressed now in a position midway between supination and pronation, with two lateral splints which are well padded. The dorsal splint should extend from just below the external condyle to the metacarpo-phalangeal joints, and the palmar from below the elbow to the heads of the metacarpal bones (Fig. 372). These splints may be fixed primarily in position by strips of

adhesive plaster which pass around each end. They should then be held evenly and firmly in position by a roller bandage, and the arm supported in a sling. The hand should be inspected each day for two or three days, and at the end of the first week or two, if the splints becomes loose, they should be removed, the arm washed with soap and water, sponged with alcohol, and then dusted with powder, when the splints are reapplied. Union is usually complete in from four to five weeks, when the splints may be left off and passive and active motion with massage instituted.

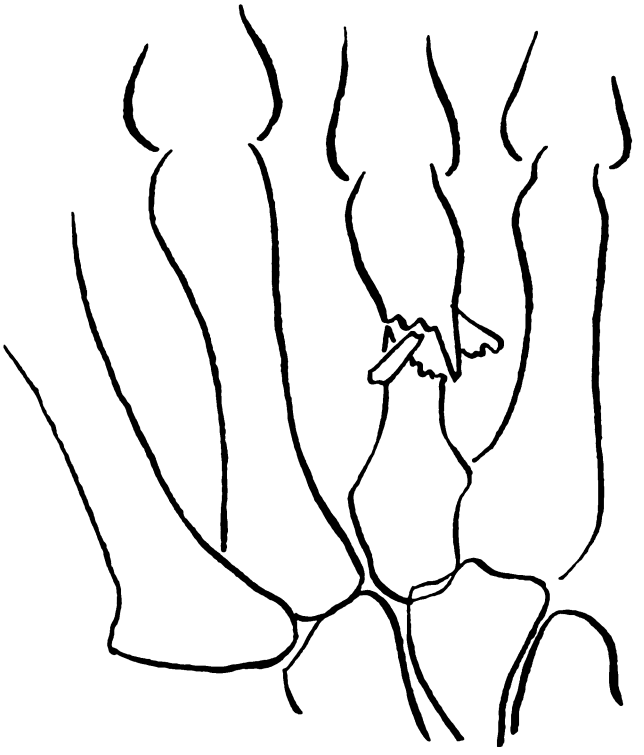


Fig. 384.—Fracture of the fourth metacarpal bone. X-ray tracing.

FRACTURES OF THE CARPUS.

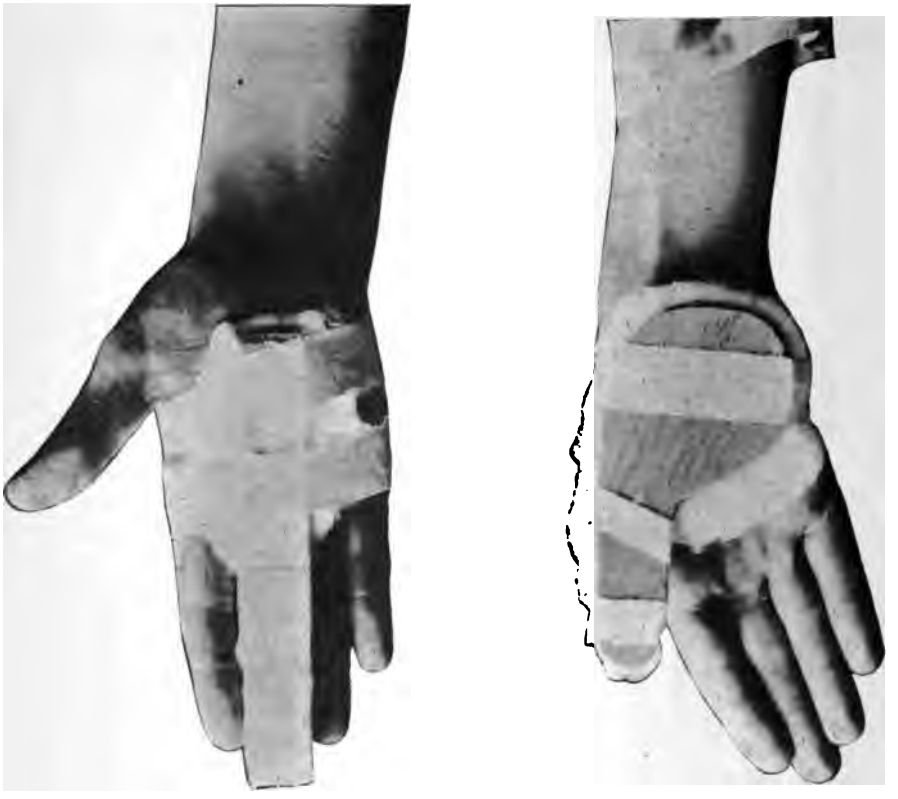
These fractures are unusual, but fracture of the scaphoid may occur in Colles' fracture or other severe injury about the wrist. Fracture of the os magnum occasionally occurs as the result of falls upon the hand. An examination with the X-ray will probably be necessary in order to establish the diagnosis.

TREATMENT.—The displacement should be reduced, if present, by extension, counter-extension and local pressure. Compresses should then be placed over the broken fragments and the wrist joint immobilized by a dorsal splint extending from the middle of the forearm to the metacarpo-phalangeal joints.

FRACTURES OF THE METACARPAL BONES.

The third and fourth bones are those usually broken. The fracture may be transverse or oblique and the displacement is often considerable. The lower end of the upper fragment is prominent on the dorsum, while the lower fragment is prominent in the palm of the hand. These fractures usually result either from direct force or a blow with the fist, the force in the latter case being received upon the knuckles (Fig. 384).

SYMPTOMS.—There is marked swelling both on the dorsum and the palm. The hand cannot be readily closed on account of the palmar swelling.



Figs. 385 and 386.—Splints for fracture of the phalanges.

There is crepitus, pain and deformity. The knuckles corresponding to the fractured metacarpal bones are displaced upwards. The metacarpal bone of the thumb may also be broken. The fracture is usually oblique and frequently extends into the joint of the trapezius.

To effect reduction of a fractured metacarpal bone the finger or thumb corresponding to the fracture should be seized with the right hand and traction made upon it while the ends of the metacarpal bone are steadied with the fingers of the left hand. After reduction a large roller bandage be placed in the palm and a compress fixed over the dorsal fragment.

the thigh in a plaster of Paris cast. Union is usually complete in from five to six weeks.

FRACTURE OF TRUE PELVIS.

This is always a serious condition, especially in consequence of the liability to injury of internal organs, such as the urethra, bladder, vagina and rectum. The fracture usually extends from the obturator foramen and may implicate the horizontal ramus of the pubis and the ascending ramus of the ischium. In connection with this fracture the sacro-iliac synchondrosis may be involved.

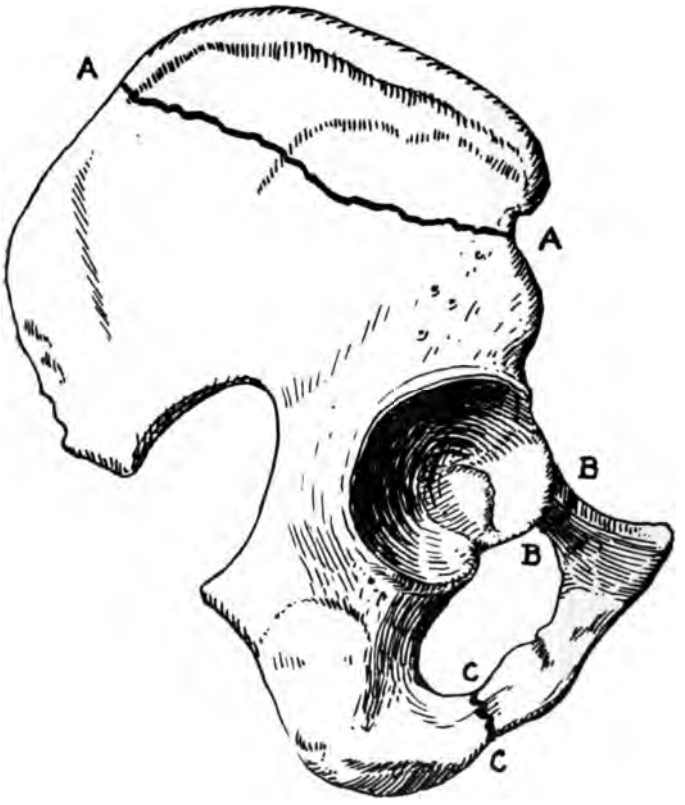


Fig. 387.—Fracture of pelvis.

SYMPTOMS.—There are shock, pain in the pelvis, inability to stand or to move one or both legs, pain on coughing or straining, crepitus and possible deformity. Crepitus and pain are elicited by moving the iliac crest.

TREATMENT.—Morphine or codein may be administered for pain. If the urethra is ruptured external perineal urethrotomy will be required. If the urine is bloody, a catheter should ordinarily be tied in the bladder and urinary antiseptics administered. In the treatment of the fracture, the pelvis and thigh should be enveloped in a plaster of Paris cast.

FRACTURES

FRACTURES OF THE ACETABULUM

FRACTURE OF THE TIBIA NECK

FRACTURE OF THE SHAFT

FRACTURE OF THE CONDYLE

FRACTURES OF THE FEMUR.

[illegible] femur presents a head, neck, a [illegible] which is covered by cartilage and [illegible] the acetabulum. The neck connects the head with the shaft and [illegible] is [illegible]. The neck is restricted in size and covered by the capsular ligament. The outer end of this ligament is attached to the rim of the acetabulum; the lower end is attached in front to the anterior inter-trochanteric line. Above this line it is attached to the inner aspect of the great trochanter, and below it to the immediate vicinity of the lesser trochanter, while posteriorly it is attached to the neck at the junction of the outer and middle thirds. The great trochanter, is, as it were, a continuation of the shaft upwards, and it is situated just above the junction of the neck and shaft. The lesse[illegible]er is situated at the junction of the neck and shaft below. T[illegible] the neck varies,

but superiorly it is from three-quarters to one inch long, and inferiorly from one and one-quarter to one and three-quarters inches long. In connection with fractures of the neck it should be kept in mind that but two-thirds of the neck posteriorly is surrounded by the capsular ligament. The greater trochanter can always, and the neck can frequently, be palpated. At times one is able to outline the lesser trochanter.

MEASUREMENTS OF THE LEG.—These are of special importance in injuries of the thigh. In making measurements to determine if shortening

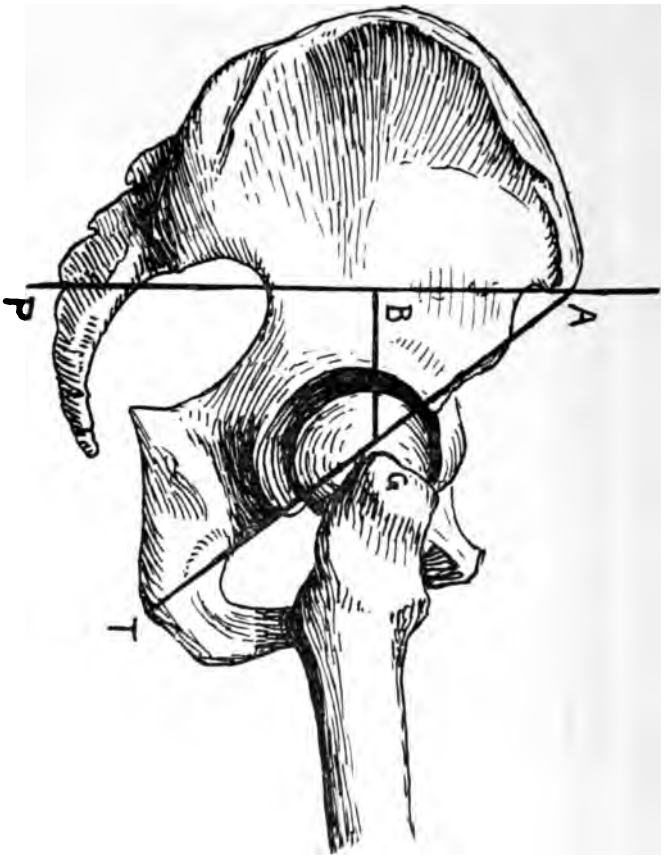


Fig. 388.—Nelaton's and Bryant's lines.

exists, one ordinarily measures from the anterior superior spinous process of the ilium to the tip of the internal malleolus. In taking these measurements the patient should lie squarely on the back, with the head, chest and abdomen in a straight line, and the legs in the same relative position. The tip of the anterior superior spinous process should be marked with an indelible pencil and also the tip of the corresponding internal malleolus. Then the same markings are made upon the opposite side and the measurements taken. One must be extremely careful in taking these meas-

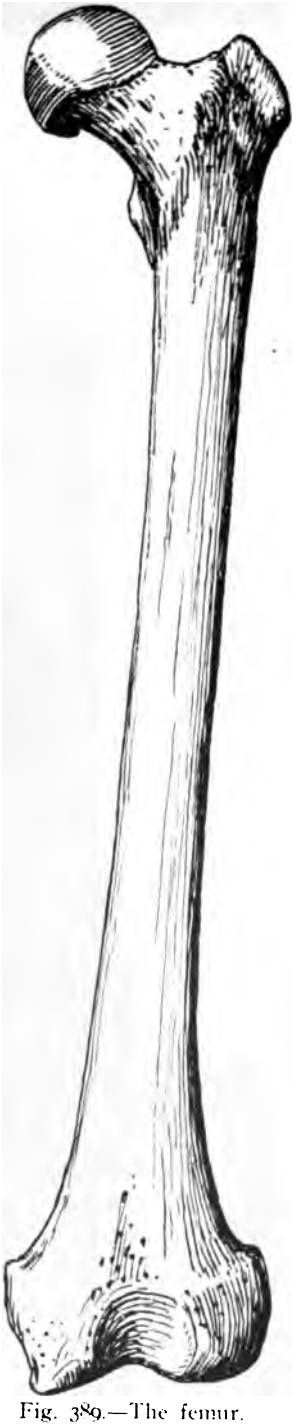


Fig. 389.—The femur.

Fig. 390.—Method of applying adhesive plaster for extension.

General Treatment in Fractures of the Neck of the Femur.—The greatest consideration should be given to the patient's general condition. He should receive frequent sponge baths, be given massage, have the appetite encouraged, the bowels kept open and the heart's action maintaind, by strychnin and caffein, if required. Pain may be relieved by codein or morphin. The lungs should be watched carefully for a hypostatic congestion, and the patient's position, if necessary, frequently changed.

Treatment of Fractures of the Hip.—The indications are to maintain the impaction if it is present, as this ordinarily secures bony union, to correct eversion and to prevent shortening. In cases due to falls upon the trochanters and where impaction is thought to be present, the principles of treatment consist in immobilizing the hip, at the same time correcting the eversion so far as this can be done without force, and in applying extension. The extension is only for the relief of muscular spasm, and the weight need not exceed from four to eight pounds. In immobilizing the hip, Thomas' hip splint is one of the best (Figs. 390 and 391). It is light, easily applied, comfortable, secures fixation of the hip, and is very helpful in moving the patient. The splint can be made, if necessary, by any blacksmith, by taking a piece of malleable iron one inch to one and a quarter inches wide, and from one-quarter to three-sixteenths of an inch thick, depending upon the weight of the individual, and of sufficient length to reach from just below the axilla to the calf of the leg. This piece is fashioned to conform to the curves of the back, hip and leg. To the lower end of this band is riveted a transverse band long enough to encircle three-quarters of the calf of the leg. A similar band is riveted at the center for the thigh, and again one to the upper end of the band to encircle the chest. The thigh and chest bands should encircle three-quarters of their respective parts. Instrument makers cover the stem and bands with soft leather. When this cannot readily be done, they may be covered with sheet wadding and wound with bandages. The splint is applied by rolling the patient upon the sound side and then slipping the bands beneath the chest and leg. When the patient is again turned upon the back the splint should fit accurately the back, gluteal region and leg. Instrument makers attach a piece of webbing and a buckle to the ends of each strap with which to fasten them. If these are not at hand, the straps may be held securely in position by a swath around the chest and by bandages over the bands which encircle the thigh and calf. Before the application of a Thomas splint extension is secured by adhesive plaster and a weight. A great many surgeons treat fractures of the neck of the femur by extension and a long side splint, the latter extending from the axilla to below the foot, where there is a cross-piece to prevent the splint's rotating. The long splint is carefully padded and fixed to the chest and abdomen by a wide swath, and to the leg by a roller bandage.

Ruth strongly advocates the Maxwell method of treatment in fractures of the neck of the femur. This treatment may be carried out as follows: First flex the thigh on the abdomen to relax the psoas and iliacus muscles; then make extension while an assistant makes traction outwards, so as to raise the trochanter to the same level as its fellow. From fifteen to twenty-five pounds weight is now to be used for downward ex-

tension. The upper half of the thigh is covered in front, on the inside and below a molded binder's board, and around this is carried a broad swath of muslin, extended by a cord which passes over a pulley elevated two or three feet above the bed, and has attached to its end a weight of from eight to sixteen pounds. The direction of this upper extension or pulley, should be upwards towards the axilla, outwards and forwards. The object of this lateral extension is to raise the trochanter and outer fragment to a level with the inner, to overcome outward rotation, to put the capsule upon the stretch, and thus maintain the fragments in position.

In the treatment of fracture of the neck of the femur in children, the patient should be put to bed, have the hip immobilized with a Thomas or long side-splint, and have a weight of about four pounds applied as an extension. After six weeks the child may be allowed to get upon crutches, with a high shoe on the well foot, and after three months it may be allowed to bear its weight on the limb.

FRACTURE OF THE SHAFT OF THE FEMUR.

Fracture of the femur may be produced by direct or indirect force. In adults the fracture is usually oblique; in children it may be transverse. The fracture may be situated in any part of the shaft, in the upper, middle or lower third. In fracture of the shaft, in consequence of the obliquity of the fractured surfaces, the strength of the muscles attached to the pelvis, femur and tibia, and the length of the femur, overriding and angular displacement or rotation of the upper or lower fragment is often very pronounced.

The force required to break a femur is usually very considerable. The symptoms are shock, severe pain, marked deformity, great mobility in the shaft of the bone, crepitus, shortening of the leg of from one to three inches, and pronounced lateral rotation of the leg below the seat of fracture.

Diagnosis.—This is readily established upon the most superficial examination, the deformity, crepitus and preternatural mobility rendering the diagnosis easy.

Prognosis.—This is usually good. Fracture of the femur is, however, always a serious accident; the shock is usually marked, injury to important vessels or nerves may occur, the patient has to be confined to bed ordinarily for about eight weeks, there is usually shortening and possibly deformity. Angular deformity and marked rotation can be overcome. Shortening occurs almost without exception. A shortening which does not exceed one inch, without other deformity, and with strong bony union, may be considered a good result and will give an eminently satisfactory limb.

FRACTURES OF THE SHAFT OR MIDDLE THIRD OF THE FEMUR.

These fractures are of frequent occurrence, and are produced by direct or indirect violence. The fracture is usually oblique. The lower fragment is ordinarily drawn to the inside of the upper. The upper fragment is drawn slightly outwards, with the result that an angular deformity is produced with its apex outwards.

Fig. 391.—Thomas' hip splint.

Fig. 392.—Long side splint with extension applied.

The symptoms are represented by shock, pain, swelling, deformity, shortening, preternatural mobility and crepitus.

The diagnosis of the fracture and its situation are readily made out by extension and slight manipulation. The direction of the fracture, as a rule, cannot readily be determined in consequence of the thickness of the overlying muscles.

TREATMENT.—In all fractures of the thigh below the trochanters the patient should be given an anesthetic for the purpose of relaxing the muscles and allowing the surgeon to make a thorough examination of the parts, and to more correctly adjust the fractured surfaces. Before the patient is anesthetized the splints and dressings should be prepared and ready for use; and as the patient is coming under the influence of the anesthetic the limb may be thoroughly washed with soap and water and then with alcohol.

When the patient is thoroughly anesthetized the examination is conducted by the surgeon grasping the condyles of the femur with one hand, and the leg with the other, while an assistant steadies the pelvis and upper part of the thigh. By extension and counter-extension, rotation and manipulation, the surgeon determines the exact location of the fracture, the displacement of the fragments, and the approximate amount of extension necessary to overcome the contraction of the muscles. The limb is then given into the hands of an assistant, who steadies it and makes some slight extension upon it. A long strip of adhesive plaster two inches wide has one end applied to the middle of the thigh, and is then carried down the side of the knee, along the leg and around the foot, a loop being secured some two or three inches long beneath the sole of the foot. The strip is then carried up the other side of the leg to the middle of the thigh. The adhesive plaster should be molded to the limb by the warm hand. It may be more securely held in position by two or three strips of adhesive plaster passing circularly around the limb, one above the knee and one or two below. The whole plaster is then held in position by a neatly applied bandage. A piece of cigar box one and one-half inches wide and four inches long is notched at each end and placed below the sole of the foot and between the strips of plaster, for the purpose of preventing pressure upon the malleoli during the traction (Fig. 390). A strong clothes line is then tied to the loop of adhesive plaster, carried over a pulley of proper height at the foot of the bed, and to this a weight may now be attached sufficient to overcome the shortening. This will ordinarily be a weight of from 12 to 24 pounds. Three coaptation splints, each well-padded, are then applied to the thigh and leg. The first splint is applied to the posterior part of the thigh and leg and extends from just below the trochanter to the middle of the calf. The second short thigh splint is applied to the inside of the thigh, and a third over its upper surface. These splints are fixed in position by adhesive plaster and then firmly secured by a roller bandage. A long side splint, well-padded, is then secured to the side extending from the axilla to below the foot, where there is a cross-piece from twelve to eighteen inches long to prevent the splint from being rotated outwards by the leg. The splint is securely fixed to the leg by a roller bandage and secured to the chest and abdomen by a wide swath (Fig. 392). During the dressings an assistant will usually make extension from the foot to assist the weight which has been applied

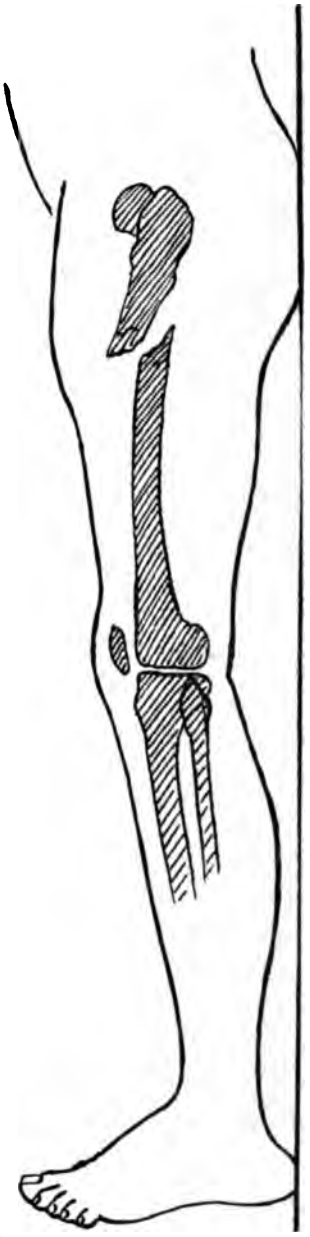


Fig. 393.—Showing displacement in fractures of upper third of femur.

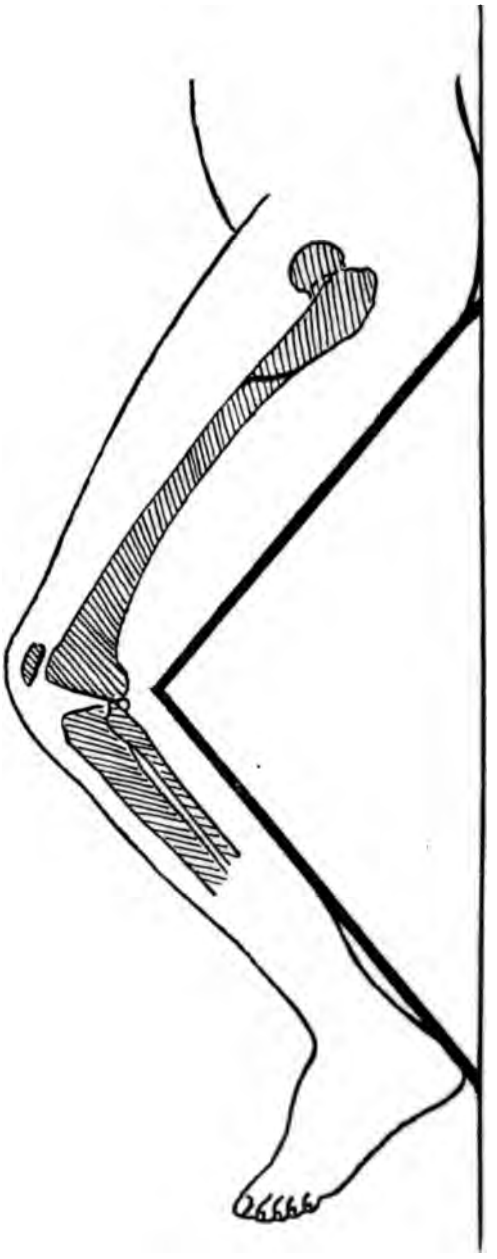


Fig. 394.—Correction of displacement by placing the limb upon a double inclined plane.

in overcoming any possible shortening. Sand bags may be placed along the limb to keep it in an upright position. The heel is protected from undue pressure by paddings, or a ring of absorbent cotton. A cradle is placed over the foot to protect it from the pressure of the clothes. The limb, bandages and splints should be inspected daily for the purpose of seeing that the circulation is not interfered with, and that the dressings are properly applied.

In treatment of fractures of the thigh it is necessary, so far as possible, (1) To prevent shortening. This is overcome by the weight and pulley, and daily measurements should be made from the anterior superior spinous process of the ilium to the external malleolus, for the purpose of ascertaining whether the limb is of normal length. (2) To prevent outward bowing of the leg. This is readily overcome by carrying the leg and thigh outwards, so that the lower fragment will correspond in position to the upper. (3) Outward rotation of the foot and leg should be prevented. This is a characteristic condition in fractures of the femur. It can ordinarily be corrected by fixing a bandage to the posterior splint, or an adhesive plaster to the calf of the leg, and carrying this under traction over the outside splint, where it is fixed. (4) In subtrochanteric fractures and supracondyloid fractures, it is often necessary to dress the limb on a double inclined plane, for the purpose of securing proper coaptation of the fragments.

FRACTURES OF THE UPPER THIRD OF THE FEMUR—(SUBTROCHANTERIC FRACTURES).

Fractures in this situation are not frequent. They may be caused by direct or indirect violence, and the displacement is usually characteristic. The upper fragment is drawn upwards by the psoas and iliacus muscles; and rotated outwards by the muscles attached to and in the immediate vicinity of the great trochanter. The lower fragment is drawn upwards and inwards by the ilio-femoral muscles (Fig. 393).

SYMPTOMS.—The symptoms of fracture in this position are shock, local pain, swelling, deformity, mobility, crepitus and shortening.

The diagnosis is ordinarily readily established by inspection and slight manipulation.

TREATMENT.—In the treatment of fractures of the upper third the fractured surfaces must be carefully adjusted and then immobilized. The fractured surfaces can be fixed ordinarily by the same splints as are used for fracture of the middle third; but at times in consequence of the abduction and flexion of the upper fragment, and one's inability to correct this displacement, it is necessary to put the limb upon a double inclined plane, in order to bring the lower fragment upon the same line as the upper (Fig. 394).

SUPRACONDYLOID FRACTURES.

These fractures may be produced by direct or indirect force. The displacement of the fragments is fairly uniform. The short lower fragment is drawn backwards by the gastrocnemius and soleus, while the lower end of the upper fragment projects in front. This fragment may pierce the skin.

while the upper end of the lower fragment may do severe injury to the popliteal vessels or nerves (Figs. 395, 396 and 397).

In the treatment reduction is effected by flexing the leg to a right angle upon the thigh, so as to relax the above named muscles, and then making

Fig. 395.—Supra-condyloid fracture of femur.

extension and counter-extension upon the limb, while the fragments are manipulated into position. If the fragments will remain in position while the leg is extended the limb may be put up in this position with a large compress over the lower fragment. Otherwise the limb should be dressed

on a double inclined plane, securing such extension as is possible by binding the thigh and leg to the splints, while extension is made from the knee to the leg (Figs. 398 and 399).

FRACTURES OF THE THIGH IN CHILDREN.

These fractures are usually produced by direct violence. They may be complete or greenstick fractures. The symptoms correspond to those present in fractures of the femur in adults.

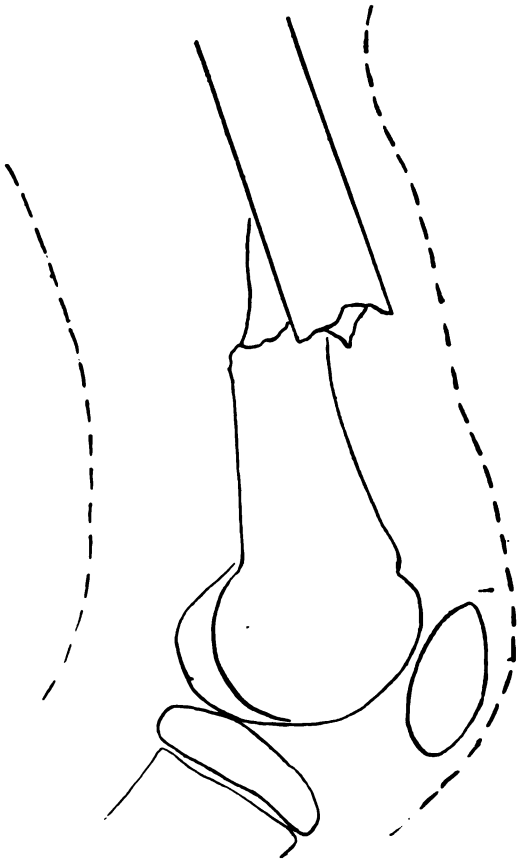


Fig. 396.—Fracture of femur—lower third. X-ray tracing.

TREATMENT.—The principles of treatment are proper adjustment and immobilization of the parts. In children over ten years of age extension with long side coaptation splints may be used, the same as in adults. In children under ten years of age the Thomas splint or Cabot's wire splint may be used, or the leg may be dressed over a double inclined plane, or suspended. The Cabot posterior wire splint may be made by taking a piece of wire about the size of a lead pencil and bending it according to Fig. 400.

The ends can be bound together by a small wire. From A to D repre-

sents the distance across the back, from A to B the distance from the axilla to a point midway between the crest of the ilium and the top of the trochanter. From A to E the distance from the axilla to below the calf of the leg. The wire splint is bent to conform to the posterior surface of the body, pelvis and leg. The splint is covered with wadding and a bandage. Swaths of strong cotton are attached to DH and AB. Before the application of the splint the child's limb is washed with soap and water and bathed with alcohol. Adhesive strips are then applied for extension, and the child placed upon the splint. The swaths are brought around the chest

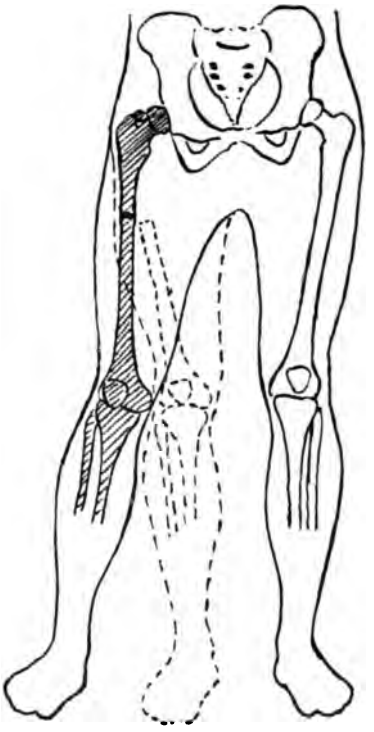


Fig. 397.—Right leg carried outwards to prevent bowing.

and abdomen and secured by safety pins. The extension is then applied and following this the limb is securely fixed to the splint. The child must be kept perfectly clean. After four weeks the child may be allowed to get about on crutches, still wearing the Cabot splint and having a high shoe upon the sound foot. After eight weeks the splint may be removed; and after eight or ten weeks the child may be allowed to walk upon the foot. In young children it is at times advisable, after surrounding the thigh with coaptation splints, to suspend it vertically. The child can be secured to the bed by a swath fastened to the mattress, or it may be fastened to a Bradford frame.

SEPARATION OF THE LOWER EPIPHYSIS OF THE FEMUR.

This epiphysis includes all of the articulating portion of the bone and has attached to it the greater portion of the gastrocnemius muscle. The

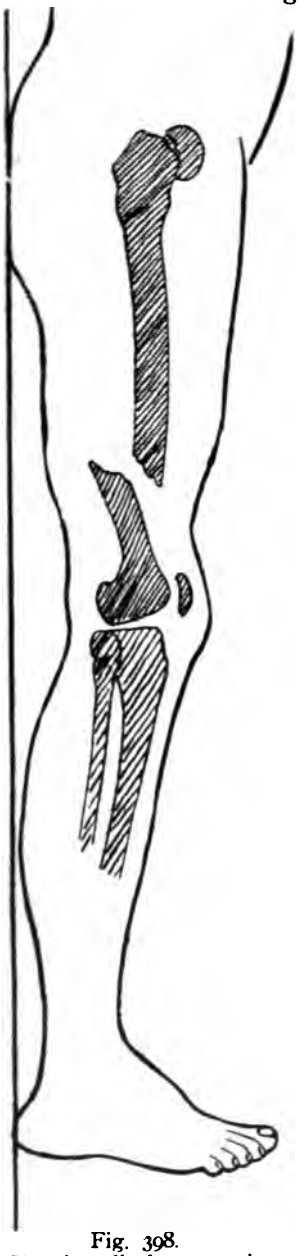


Fig. 398.
Showing displacement in supra-condyloid fractures.

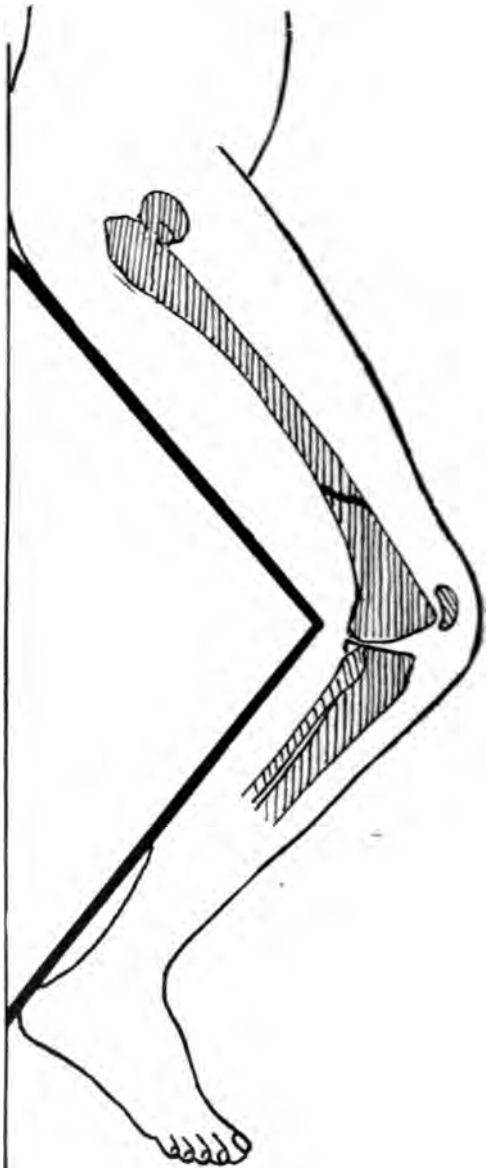


Fig. 399.—Method of correcting displacement in supra-condyloid fractures.

lower epiphysis unites with the shaft at about the twentieth year. The ligaments above the knee joint are attached to the epiphysis and in any severe strains upon the joint, as in over-extension or in lateral motion, the strain comes upon the ligaments and epiphysis, and if severe enough the epiphyseal cartilage may give way and the epiphysis be separated from the diaphysis. The common cause of the accident is the catching of the foot in a revolving wheel. The child is usually under ten years of age.

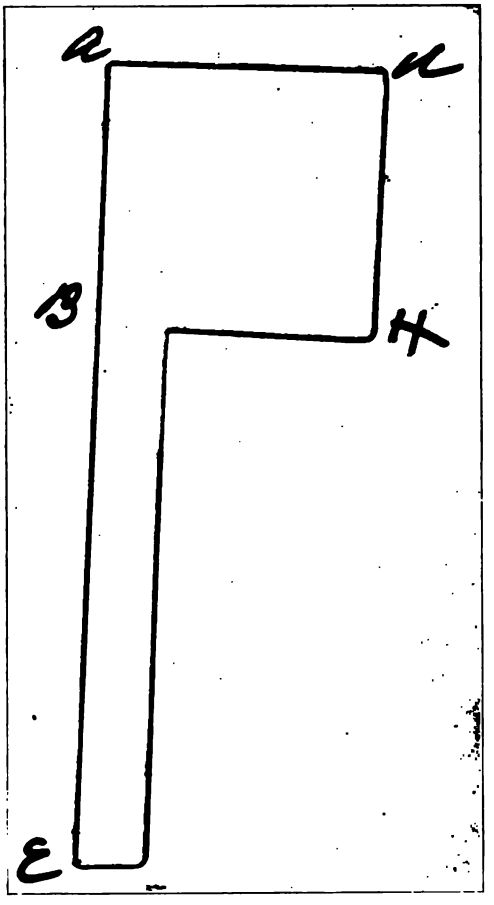


Fig. 400. Cabot's wire splint.

DISPLACEMENT.—The separation being caused by over-extension or by rotation of the foot, the epiphysis is displaced forwards and the lower end of the diaphysis backwards and downwards into the popliteal space, where in about one-half of the cases, it pierces the skin (Fig. 401).

COMPLICATIONS.—The popliteal vessels may be severely pressed upon, injured or lacerated, resulting possibly in gangrene of the limb. The nerves may be pressed upon, causing severe pain. The epiphyseal separation may be compound.

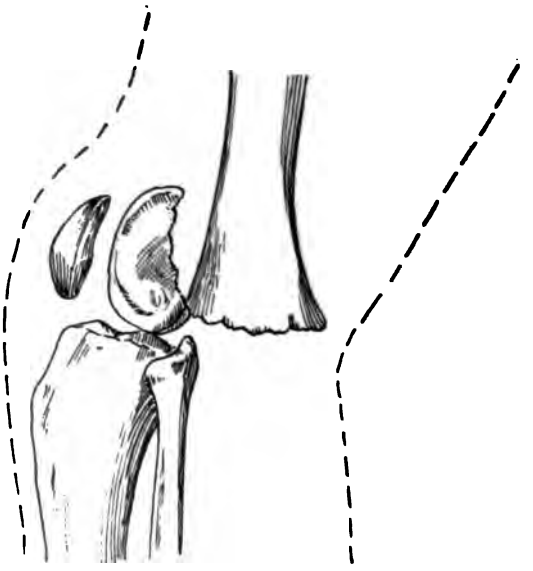


Fig. 401. Separation of lower epiphysis of femur. X-ray tracing.

SYMPTOMS. There are severe pain, shock, preternatural mobility, deformity and soft crepitus.

DIAGNOSIS. The injury is to be differentiated from dislocations and from supracondylar fractures. Dislocations are rare in childhood. In dislocation the parts are fixed, there being almost no motion at the articulation; and the ends of the dislocated bones can readily be felt. Supracondylar fracture is usually situated higher up than is epiphyseal fracture. It does not necessarily occur before adult age, and in fracture the upper end of the lower fragment is displaced backwards, the very opposite of what occurs in epiphyseal separation.

PROGNOSIS.—In cases of epiphyseal separation, growth may be arrested in consequence of injury to the cartilage. The circulation in the foot and leg in these injuries should always be examined in consequence of the possibility of its being shut off as the result of injury or to pressure upon im-

Fig. 402.—Cradle for protecting the foot from the bed clothes.

portant vessels. The separation is usually transverse and consequently shortening is ordinarily slight.

The prognosis may be said under ordinary conditions to be good.

TREATMENT.—In some cases there will be such injury to the soft parts, including the vessels, that amputation will be necessary. In laceration of the soft parts, exposing the ends of the bones, reduction should be effected, the wound drained, and the parts held in apposition by suitable splints and dressings. Reduction is not always easy, in consequence of the hamstring and quadriceps muscles forcing and holding the head of the tibia strongly against the lower end of the diaphysis. Reduction can usually be accomplished by an assistant making strong traction upon the flexed leg, while the surgeon manipulates the fragments into position by grasping the thigh with his hand and pushing downwards with his thumbs upon the epiphysis, while he pulls the lower end of the diaphysis upwards into position with his fingers. In case the surgeon does not succeed in effecting reduction by manipulation, the ends of the bones may be exposed by an incision placed along the outer side of the shaft. The lower fragment may then be slightly freed from the grip of the surrounding soft tissues and while extension is made on the flexed leg, it is forced into position. After reduction the leg should be flexed to a right or an acute angle, and held in position by a light plaster of Paris cast. After four weeks the leg may gradually be brought down to the straight position. After five weeks the patient may bear some weight upon the foot (Fig. 402).

FRACTURES OF THE PATELLA.

Fractures of the patella are due either to muscular contraction or to direct violence. Often both of these factors are present in the same case. The patient falls upon the strongly flexed knee, while the quadriceps extensor cruris is in a state of strong contraction. In these cases the patella is taken at a great disadvantage, it being only partialy supported by the convexity of the condyles, while the muscular cross strain is very great.

The fracture is often transverse. The bone, however, may be comminuted. In some cases only the thinnest shell of bone, or only the fibrous aponeurosis is torn off with the attachment of the quadriceps.

SEPARATION OF THE FRAGMENTS.—This may be slight or very considerable, depending upon the degree of separation of the fibrous investment, and the extent of rent in the vasti muscles which are attached to the sides of the patella with the fascia lata. In cases due to direct force the fracture is likely to be stellate and the separation slight. If the fracture is due largely to sudden and violent muscular contraction, the break is likely to be transverse and the fragments widely separated.

In fractures of the patella the joint cavity is practically always open and quickly becomes distended with blood and synovial fluid, which tends to push the fragments still further apart. The fibrous investment which covers the anterior surface of the patella is torn unequally and falls over the ends of the fractured surfaces.

In complete fracture the upper fragment is usually turned perpendicularly inwards, so that the fractured surface looks into the joint. This position of the upper fragment is caused by the contraction of the fibers of the

vasti muscles which are inserted into the sides of the patella, dragging it upwards and backwards.

SYMPTOMS.—There are pain, inability to extend the leg or stand upon the foot, quickly occurring swelling, crepitation on manipulation if the fragments are in contact, and irregularity of the fragments. If the fragments are separated a notch may be felt between them.

TREATMENT.—This will depend upon the position of the fragments. If they are approximated or can be readily approximated by manipulation, they should be maintained in position by the application of two broad strips of adhesive plaster, one of which fixes the upper fragment and is then carried diagonally downwards across the sides of the limb, while the second plaster is carried from the lower fragment diagonally upwards across the limb. The limb should then be supported by a well-padded posterior splint, and securely bandaged. At the end of every week the splint should be removed, the limb massaged, washed, and the dressings reapplied. At the end of four weeks the splint may be left off, if the union seems fairly good, and passive motion resorted to, with massage. The limb, however, should be bandaged and the knee protected from injury during exercise, for another week or two, by a light posterior pasteboard splint. In cases in which the fragments cannot be accurately adjusted the joint should be opened under the strictest antiseptic precautions, by either a perpendicular or transverse incision, the blood clots turned out, the shreds of fascia which overlie the ends of the bone trimmed off and the fractured surfaces accurately adjusted and wired together by strands of strong silver or annealed iron wire. After closure of the superficial wound the limb should be put up on a posterior splint which is supported by a snugly fitting bandage. After a few weeks union is usually sufficiently strong to allow the patient to be about on crutches. The knee, however, should not be bent until the end of the fifth, or during the sixth, week, when passive and active motion may be instituted. Treatment of fractures of the patella by open incision in the great majority of cases gives most satisfactory results, the union being a bony one. Without operation there is a fibrous union which, if short, may be very satisfactory, but if long may entail consideral functional disability.

FRACTURES OF THE BONES OF THE LEG.

Fractures of the bones of the leg are second in order of freqnency only to those of the forearm. In the majority of cases both bones are broken. The tibia and fibula are separately fractured in about equal degrees of frequency. Compound fractures are more often met with here than in any other part of the body, in consequence of the superficial position of the tibia and the great violence to which the bones of the leg are often subjected. Fractures through the lower third are most frequent, although fractures through the middle and upper third are not uncommon. Fractures through the upper and middle thirds are most frequently caused by direct violence, while those of the lower third are more often the result of indirect force, as falls upon the everted foot. Fractures through the upper third of the tibia are frequently transverse, while fractures through the shaft of the tibia or fibula are usually oblique. When both bones are broken the fibula is usually fractured at a higher level than the tibia.

Displacement of the Fragments.—This will depend upon the direction of the fracturing force and upon muscular action. When but one bone is broken the displacement is often not marked, in consequence of the other bone acting as a splint. When both bones are broken in the middle or lower thirds, overriding is often pronounced because of the obliquity of the

Fig. 403.—Fracture of tibia and fibula—marked displacement.

fractures and the contraction of the powerful muscles of the leg. In fractures through the shaft of the tibia, angular deformity is frequent, the lower end of the upper fragment projecting beneath the skin, while the upper end of the lower fragment is drawn upwards behind the upper fragment. The apex of the angle in fractures of the shaft of the tibia and fibula may be

either anterior or posterior, depending upon the direction of the fracture and the fracturing force. Rotation of the foot and lower fragment is also frequent (Fig. 403).

Symptoms.—There are shock, pain, marked swelling, deformity, crepitus, and, if both bones are broken, shortening.

Diagnosis.—If there is a fracture through both the tibia and fibula the diagnosis is readily established. If but one bone is broken it is by no means always easy to establish the fact of a fracture, especially if there is

Fig. 404.—Comminuted fracture of tibia and fibula, lower third. X-ray tracing.

much swelling. The fracture, if one is present, is always situated at the point of greatest swelling and tenderness. In some cases of fracture of the fibula, there may be but little swelling or tenderness, and the patient not infrequently is able to walk upon the foot with the aid of a cane.

In making the examination the thigh should be supported by an assistant, when the surgeon grasps the instep firmly with one hand and makes extension, while with the other he palpates the entire length of both bones, for the purpose of ascertaining irregularities or tender spots, if any such exist. He may then make alternate lateral or antero-posterior pressure, for the

purpose of eliciting crepitus or preternatural mobility. In some cases of fracture of the fibula, neither crepitus nor preternatural mobility can be elicited by the use of moderate force. In these cases the diagnosis of fracture may be considered probable if a very tender, sensitive area of the bone is discovered, with swelling of the overlying soft parts. In examining a limb for fracture, the pain inflicted will be much less if strong extension is made during the examination, as this will prevent, in a great measure, the ends of the bone nagging the flesh. If the patient is very sensitive an anesthetic may be necessary during the examination and adjustment of the fractured surfaces.

In taking measurements to determine the presence or absence of shortening, the distance from the top of the internal tuberosity of the tibia to the tip of the internal malleolus should be determined and compared with the same measurements of the corresponding leg (Fig. 404).

Treatment of Fractures of the Shaft.—The principles of treatment are to adjust the fragments if they are displaced, to prevent shortening and to immobilize the fragments until firm union has taken place. Fractures of the tibia or fibula, one or both, in which the swelling is not pronounced nor the displacement great, are best treated by the immediate application of a plaster of Paris cast. The limb is first washed with soap and water, sopped with alcohol and then dusted with powder. An assistant makes extension upon the foot sufficient to overcome the shortening, if any is present; a second assistant steadies the thigh while the surgeon manipulates the bones into position. The limb should be enveloped in a liberal amount of sheet wadding, or absorbent cotton, held in place by a loosely fitting gauze bandage, and while extension is made and the fragments maintained in position, the surgeon applies the plaster bandages, which should reach from the toes to the middle of the thigh. The plaster of Paris bandage should be uniformly but rather loosely applied, so as to make allowance for any possible swelling. During the application of the bandage the foot should be held at a right angle with the leg, while the knee is slightly flexed upon the thigh. The condition of the toes and limb should be noted daily. If the toes become unduly swollen, blanched, or bluish, or if the limb throbs, is very painful or numb, the plaster cast is too tight and should be cut down the center and loosened or removed. If removed it may be reapplied, but more loosely, and its cut edges are held in place by a roller bandage. In consequence of the disappearance of the swelling, the cast ordinarily becomes too loose by the end of the first week, and should then be cut down the front and removed. During this procedure an assistant makes traction upon the foot while a second steadies the thigh. After the removal of the cast the leg should be examined, washed, dusted with powder, covered with cotton and a new cast applied. This cast can usually be left on for three or four weeks. During this time the patient can, if he desires, go about on crutches. At the end of five weeks the cast may be removed, the limb washed and massaged, and a shorter cast applied, reaching only to the knee. This cast, if thought best, may be cut down the center and each day removed, the limb washed and massaged. After the fifth week, passive and active motion of the knee joint should be instituted, and by the end of the tenth or eleventh week following the injury, the patient may be allowed to walk with a cane.

[illegible]—In some cases in [illegible] the surgeon [illegible] the swelling [illegible] the vitality of the limb [illegible] should be made through the [illegible] of blood and inflammatory [illegible] this class of cases to maintain [illegible] as the incision has [illegible] not necessary and after [illegible] manipulation for the purpose of [illegible] be enveloped in sheet wadding [illegible] posterior splint gives support [illegible] from sagging backwards. [illegible] of the leg. These splints [illegible] by a roller bandage, [illegible] four or five days, or as [illegible] may with advantage be [illegible] fractures involving the [illegible] it may be necessary to [illegible] two weeks, in order to [illegible] may be applied by encircling [illegible] which three or four turns [illegible] of the bandage being secured [illegible] muslin bandage are then [illegible] the foot. From this a [illegible] it a sufficient weight to maintain [illegible]

COMPOUND FRACTURES OF THE LEG.

[illegible] of very frequent occurrence. The principle [illegible] asepticize the wound, provide for drainage and the [illegible] the parts. In these cases the patient should [illegible] the limb thoroughly scrubbed and then shaved. The [illegible] enlarged if necessary, thoroughly scrubbed with soap and water [illegible] with a solution of bichloride and perfectly drained. Strips of iodoform gauze are suitable for this purpose. Dependent drainage should always be established by counter openings if necessary. A large dressing is then applied and the leg supported by a splint. A suitable splint is the Cabot posterior wire splint, supplemented by side coaptation splints. The posterior wire splint is made of iron wire about the side of an ordinary lead pencil, the lower portion being bent at nearly a right angle to support the foot. The remainder of the splint supports the calf, knee and lower part of the thigh. The wire is wound with sheet wadding, then with a bandage, and covered with strong muslin (Fig. 405).

In treatment of compound fractures of the leg it is necessary to maintain the wound in as nearly an aseptic condition as possible, and this can only be accomplished by a daily change of dressings, at least while the discharge is at all profuse. In changing the dressings the leg need not necessarily be removed from the wire splint, simply the side splints being let down, the

l sponged off and clean dressings appli
:ture where the fractured surfaces ar

Fig. 405.—Cabot's posterior wire splint.

may be necessary to apply extension
ound fractures, if kept reasonably ase

immobilized, heal readily, although safe union requires a little longer time than in simple fractures.

POTT'S FRACTURE.

This is a very common injury and usually consists of a transverse fracture of the base of the internal malleolus, rupture of the tibio-fibular ligament, and a fracture of the fibula about three inches above the tip of the external malleolus. The injury is usually caused by a fall with the knee ad-

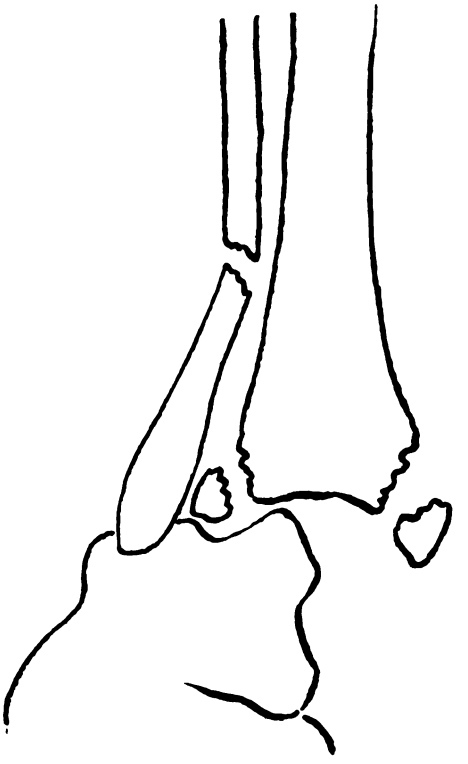


Fig. 406.—Pott's fracture. X-ray tracing.

ducted or carried across the other limb, while the foot is everted and abducted. This brings the strain largely upon the internal lateral ligament and internal malleolus. It is held that when eversion of the foot is the main factor in causing the injury, the strain primarily comes upon the internal lateral ligament, and the internal malleolus breaks off square at its base. Then the foot is pressed outwards, rupturing the tibio-fibular ligament and breaking the fibula close above the malleolus. If, however, strong abduction of the anterior portion of the foot is added to the eversion, then there is but a marginal fracture of the internal malleolus; or instead of this, a rupture of the internal lateral ligament, and following this a rupture of the

-fibular ligament, and as the foot is carried outwards, an oblique f
of the fibula some three or four inches above the tip of the malleolu
COMPLICATIONS.—The fracture is occasionally rendered compoun

Fig. 407.—Pott's fracture.

internal malleolus being forced through the skin. The foot is al
placed outwards and often slightly backwards. In some cases instea

rupture of the tibio-fibular ligament, a thin shell of bone is broken off from the external surface of the tibia.

SYMPTOMS.—The foot is displaced outwards, causing marked deformity, swelling, pain and often crepitus on motion. The pathognomonic signs are abnormal lateral mobility, displacement of the foot outwards, and at times crepitus.

In Pott's fracture there are three tender points which can ordinarily be made out by finger tip pressure. One of these is at the base of the internal malleolus; a second from two to four inches above the tip of the external malleolus; and a third in front of the ankle at a point between the tibia and fibula, and at the site of the tibio-fibular ligament. The tender points are also the site of marked swelling, which is of early occurrence (Figs. 406 and 407).

PROGNOSIS.—If complete reduction is secured and maintained, and the patient kept off his feet until union is firm, the result is usually satisfactory, the patient regaining full use of the joint. If the outward displacement is not fully corrected, the weight of the body is brought too far to the inner side of the foot, producing constant strain on the internal lateral ligament, causing severe pain, lameness and inability to walk any considerable distance. If the backward displacement is not corrected, dorsal flexion is limited.

TREATMENT.—In effecting reduction the patient should be given an anesthetic, and then if it is the right foot, this is grasped with the surgeon's left hand, so that the thumb reaches to or just above the tip of the internal malleolus, while the hand is carried about the sole and the fingers grasp the region of the external malleolus. The leg is then steadied by the surgeon's right hand and the foot carried forcibly inwards against the internal malleolus. At the same time it is lifted forward and the external malleolus pressed inwards. The foot is then immobilized in a strongly inverted and adducted position (Fig. 408). This may be effected by a plaster of Paris cast, or by Dupuytren's splint (Fig. 409). This splint may be made by taking a piece of board one-half an inch thick, and as wide as the thickest part of the calf, and long enough to extend from the middle of the thigh to six inches below the foot. The lower end may be serrated by cutting one or two notches in it. The splint is heavily padded on its internal surface, the padding extending from above downwards to just above the internal malleolus. The splint is firmly secured to the thigh and upper half of the leg by a roller bandage. The foot is then strongly inverted, lifted forward and bound to the lower end of the splint by a roller bandage, making figure-of-eight turns about the foot, instep, ankle and heel. These turns should not pass above the external malleolus for fear of pressing the fragments inward towards towards the tibia and causing an eversion of the foot when healing has been effected. At the end of the fifth or sixth week the splint may be discarded, the foot and leg massaged each day and then supported by a well-fitting bandage. At the end of eight weeks the patient may be allowed to walk upon the foot with the aid of a cane. In cases in which proper inversion has not been maintained, the foot falls outwards and the line of support instead of being through the center of the foot, falls over the first metatarsal bone or inside of the

Fig. 408.—Position in which a Pott's **fracture** is dressed. Lateral splints.

Fig. 409.—Dupuytren's splint.

foot. In these cases in consequence of the eversion the strain upon the internal lateral ligament, the pain and fatigue in walking, it is advisable to expose the seat of fracture in the fibula by a short incision, and divide the bone with a sharp chisel. The foot is then dragged strongly inwards, adducted and maintained in this position during the healing of the bone. The results of the operation are most satisfactory.

FRACTURE BY INVERSION OF THE FOOT.

This form of fracture is rare, but may occur as the result of falls upon the strongly inverted foot. In these injuries both malleoli may be broken and the foot dislocated inwards. In the treatment of the injury the deformity should be corrected, the bones manipulated into position, and the foot and leg put up in a plaster of Paris cast.

FRACTURE OF THE BONES OF THE FOOT—FRACTURE OF THE ASTRAGALUS.

This is usually due to falls from a height, the bone being broken between the tibia and the os calcis. The line of fracture may be transverse, longitudinal, horizontal, or the bone may be comminuted. The injury is often associated with fracture of the os calcis, dislocation of the ankle, and even fracture of the fibula. The fracture may be compound, and with or without marked displacement of the fragments. In fractures of the astragalus there are severe pain, great swelling, inability to move the foot, flattening of the foot and often crepitation.

Diagnosis.—In endeavoring to establish this one should take into consideration the kind, extent and manner of reception of the injury. In consequence of the protected situation of the astragalus and the very pronounced swelling which early occurs, positive diagnosis is often impossible without the aid of an X-ray picture.

Treatment.—The parts should be forced into position by extension, counter-extension and manipulation. The limb is then immobilized by a plaster of Paris cast. If a fragment is markedly out of position and cannot be reduced, it may be exposed by incision and removed.

FRACTURE OF THE OS CALCIS.

These fractures are usually caused by a fall from a height upon the sole of the foot. A fracture may occur here as the result of powerful muscular contraction, the tendo Achilles tearing away a thin shell of bone. In falls upon the sole of the foot the bone is often crushed.

Symptoms.—There are present pain, tenderness, swelling and an inability to bear weight upon the heel; the transverse diameter of the heel is increased, while the perpendicular diameter is diminished; the malleoli are nearer the sole of the foot than normal; crepitation is either obscure or absent.

Treatment.—The parts should, as far as possible, be molded into position. The ankle and foot are then immobilized and a plaster of Paris cast applied, which should be worn for three or four weeks.

Open fractures of the astragalus or os calcis usually heal readily if asepsis can be maintained.

FRACTURES OF THE METATARSAL BONES.

These fractures are rare, but may occur as the result of direct violence. The displacement is usually slight, swelling and pain are pronounced, and crepitus may be present.

In the treatment the displacement should be corrected and the foot and ankle immobilized for three or four weeks.

FRACTURES OF THE PHALANGES.

These fractures are usually caused by crushing injuries.

In the treatment the sole of the foot should be supported by a well-fitting plaster cast. Union takes place in from four to five weeks.

CHAPTER XIX.

DISLOCATIONS OR LUXATIONS.

By this is meant a condition in which one of the bones entering into a joint is displaced.

The dislocation takes its name from the distal of the two bones entering into the joint. Thus, in dislocation of the shoulder, it is the head of the humerus that is displaced, and not the scapula.

Dislocations may be classified according to their causes into (1) Traumatic; (2) Congenital; (3) Spontaneous; (4) Pathological.

Dislocations are also spoken of as complete and incomplete.

TRAUMATIC DISLOCATIONS.

These may be due to direct or indirect force, or to muscular action. They are due to direct force, as when a blow, or the force of a fall, is received directly upon the outer side of the shoulder. This is a frequent cause of dislocations at this point.

Dislocations are more often due to the application of indirect force. In this form the violence is applied at some distance from the joint, and usually through a bone, which acts as a lever.

Falls upon the strongly abducted hand frequently cause dislocations at the shoulder or elbow.

Muscular Action. When the arm is strongly elevated over the head the sudden forcible contraction of the scapulo-humeral muscles may force the head of the bone outwards, or downwards and inwards and out of its socket. In opening of the mouth beyond the normal limit, strong muscular contraction may force the condyles out of their sockets and into the zygomatic fossæ.

Age.—Dislocations are uncommon in childhood in consequence of the strength of the joint capsule being ordinarily greater than the connection between the epiphysis and diaphysis. Epiphyseal separations are consequently frequent in childhood. In old age, because of atrophy of the bone and loss of muscular elasticity, fractures near the joints are frequent, and dislocations comparatively rare.

Sex.—Dislocations are about three times as frequent in males as in females. This is unquestionably due in a large measure to the exposed occupations of men subjecting them to more accidents.

PATHOLOGY.—In dislocations the capsule is always torn at the point where the head of the bone leaves the joint. This rent may be small, simply allowing the head to pass through it, or it may be quite extensive, tearing three-quarters or almost the entire capsule away from the bone. A small

may add to the difficulty of reduction, while a large rent subsequently favors spontaneous dislocation. The untorn portion of the capsule being put strongly on the stretch, gives the limb its characteristic position, and the dislocated bone its fixation. The soft parts outside the capsule are more or less contused and lacerated, and the end of the bone may even be driven through the skin, producing a compound dislocation.

Vessels and Nerves.—The important vessels and nerves at the shoulder, elbow and knee, are often injuriously pressed upon, and occasionally lacerated by the head of the displaced bone. Not very infrequently in dislocations a neighboring tuberosity or trochanter is broken off, and in so-called fracture dislocations, the shaft of the bone is broken in addition to the luxation. Following a dislocation there is usually a severe synovitis, with the accumulation of a quantity of synovial fluid.

SPONTANEOUS DISLOCATIONS.

These are produced by the slightest force. Spontaneous dislocation is quite frequent at the shoulder and may occur from simply elevating the arm. These are usually cases in which at the primary dislocation the capsule was widely torn.

PATHOLOGICAL DISLOCATIONS.

These are the result of some intra-articular disease, as in hydrops of the hip, in typhoid fever, or of the knee-joint in Charcot's disease.

COMPLETE AND INCOMPLETE DISLOCATIONS.

A complete dislocation is one in which the articulating surfaces are completely separated, while incomplete dislocation, or subluxation, is one in which the articulating surfaces are still partially in contact.

SIGNS AND SYMPTOMS OF DISLOCATION.—These may be divided into the following classes: (1) those apparent on inspection; (2) those determined by palpation and motion; and (3) those due to interference with function.

Inspection.—By inspection the general position of the limb is determined, its contour, the presence or absence of deformity and shortening.

Palpation and Manipulation.—By palpation one endeavors to determine if the head of the bone is in its normal, or in an abnormal, position. If either of these factors can be determined, the existence or nonexistence of a dislocation is established. By manipulation it is determined if the joint is fixed or normally movable, a dislocated joint being practically always fixed.

Function.—Loss of function is characteristic of a severe injury. If the patient is able to move the joint with some freedom, it is not dislocated.

Differentiation from Contusions and Sprains.—This is readily effected, as in the latter conditions the bones are in position, not fixed, and can be moved.

From Fractures.—In fractures there is abnormal mobility, while in dislocations normal range of motion is much reduced. In fractures there is crepitus; in dislocation none. In fractures the deformity returns after

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] DISLOCATIONS

[illegible] separated the [illegible] the head of the bone. [illegible] a large [illegible]

SPINAL DISLOCATIONS—DISLOCATION OF THE LOWER JAW.

[illegible] protected from injury by its deep [illegible] zygomatic arches. Special [illegible] The glenoid cavity is shallow, the [illegible] condyles, and when the [illegible] thrown upward upon the [illegible]

[illegible] occurs about two to three per cent. of all dislocations.

[illegible] dislocation may be effected in the extraction of a tooth, in getting the mouth widely open with a gag, in laughing, yawning, or in one's effort to take a bite of a large apple. The displacement may be unilateral or bilateral.

PATHOLOGY.—In dislocation of the inferior maxillary the condyles pass forward into the zygomatic fossæ without marked injury to the soft parts, the capsule not being lacerated.

SYMPTOMS.—In bilateral dislocation the mouth is widely opened and cannot be closed, the chin, however, may be still farther depressed and the jaw is fixed in its new position by muscular contraction. On examination a hollow can be felt in front of the ear, and the rami can be palpated as they pass forward to the zygomatic fossæ. Saliva dribbles from the mouth, and the patient suffers severe pain in the jaws, sides of the head and ears, in consequence of injury to the inferior maxillary nerves.

UNILATERAL DISLOCATION.—Where but one condyle is dislocated, the jaw is carried to the opposite side. The mouth is opened and the jaw fixed.

DIAGNOSIS.—This is readily established by the appearance, the fixed position of the jaw, and the manner of production of the accident.

TREATMENT.—Reduction is effected by placing the thumbs, protected by gloves or bandages, upon the last molar teeth, while the fingers grasp the rami. Direct downward pressure is then made by the thumbs, for the purpose of releasing the condyles from the zygomatic fossæ, and carrying them over the eminentia articularis backwards into the glenoid fossæ. The thumbs should be protected, as the jaws are likely to come together with force when reduction is accomplished.

DISLOCATIONS OF THE CLAVICLE—STERNAL END.

Dislocations of the sternal end of the clavicle are infrequent, but may occur as the result of falls upon the shoulder, from blows received over the sternal end of the clavicle, or as the result of muscular action. The direction of the dislocation may be either forwards, upwards or backwards. Forward dislocations are most frequent and are caused by falls forcing the shoulder backwards. In these cases the end of the clavicle rests upon the anterior surface of the sternum, below its normal position. The degree of displacement depends upon the extent of rupture of the costo-clavicular ligament.

SYMPTOMS.—The sternal end of the bone is to be seen resting upon the sternum, the head is inclined to the injured side, and the shoulder is displaced downwards and inwards.

UPWARD DISLOCATION.

This is caused by falls or blows upon the top of the shoulder, or by a dragging of the arm and shoulder downwards.

SYMPTOMS.—The head of bone rests in the episternal notch in front of the trachea. The shoulder is depressed and approximated to the median line.

BACKWARD DISLOCATION.

These are usually caused by blows directly upon the front of the bone, the sternal end is displaced backwards, and beneath the upper portion of the sternum, pushing the trachea to the opposite side, and often making pressure upon the œsophagus.

SYMPTOMS.—The shoulder is raised and approximated to the median line. Respiration and deglutition may be seriously interfered with in consequence of pressure upon the trachea and œsophagus. A hollow exists at the sterno-clavicular articulation, and the head of the bone may be felt behind the sternum.

DIAGNOSIS.—The diagnosis of the different displacements is readily made on inspection and palpation.

PROGNOSIS.—A good functional result is usually obtained, although retention of the bone in position is difficult and often impossible.

TREATMENT.—Reduction can usually be effected by carrying the shoulder outwards and upwards, or outwards and backwards, while traction or pressure is made upon the end of the displaced bone.

A pad should then be placed in the axilla and the arm and forearm secured to the side by a Sayre's or modified Velpeau's dressing. Or the shoulder may be supported by a figure-of-eight posterior bandage. At the same time a pad may be placed over the internal end of the clavicle and secured in position by a wide strip of adhesive plaster.

DISLOCATIONS OF THE ACROMIO-CLAVICULAR JOINT.

In this dislocation the acromion is forced either below or above the outer end of the clavicle. The dislocation is caused by falls or blows upon the acromion, or outer aspect of the shoulder, or is due to violence applied to the under surface of the clavicle. The degree of displacement varies according to the extent of the injury to the coraco-clavicular ligament.

SYMPTOMS.—In the subclavicular dislocation the shoulder is depressed and approximated to the median line, the outer end of the clavicle is prominent and rides above the acromion, the clavicle seems elevated, and the supra-clavicular hollow is deepened.

TREATMENT.—Reduction is readily effected by raising and carrying the shoulder outwards, while at the same time direct pressure is made upon the outer end of the clavicle. A pad should be placed in the axilla, and a Sayre's dressing applied as for dislocations of the internal end of the clavicle. A compress should be placed over the other end of the clavicle and secured firmly in position by a wide piece of adhesive plaster, which passes from the chest over the shoulder and down the back.

DISLOCATIONS UPWARDS.

This displacement is rare, but may occur as the result of force applied to the clavicle from above or to the shoulder from below.

SYMPTOMS.—The outer end of the clavicle is depressed, the acromion process is prominent, the shoulder falls and approximates the center line, and the movements of the shoulder are very painful.

TREATMENT.—Reduction may be accomplished by carrying the shoulder outward, while the clavicle is pulled upwards. A pad should then be placed in the axilla, and the arm secured to the side. While reduction is comparatively easy it has been found most difficult to retain the bones perfectly in position.

DISLOCATIONS OF THE SHOULDER.

These constitute about fifty per cent. of all dislocations, which may be accounted for by the free mobility and anatomical arrangement of the shoulder joint. The glenoid cavity is shallow and small, offering only about one-third of the surface area of the head of the humerus. The capsule is loose and has but little support at its lower and inner parts. The shoulder is prominent and frequently exposed to injury, and the length of the humerus often affords a leverage which acts upon the capsule and surrounding structures.

Fig. 410.—Subcoracoid dislocation of left shoulder.

Dislocations at the shoulder are largely confined to adult males. In children separation of the upper epiphysis of the humerus, or fracture of the clavicle, occur as the result of injury rather than dislocation.

Dislocation at the shoulder is usually caused by falls upon the outstretched hand or elbow, the arm being elevated and abducted. The head of the humerus is driven through the inner and lower part of the capsule into the axilla (subglenoid or subcoracoid dislocation).

Dislocations of the shoulder are also frequently caused by direct violence, as falls upon the shoulder.

Dislocations of the shoulder have been divided into four varieties, depending upon the position which the head assumes after the luxation has occurred.

These are

(1) Subglenoid dislocations,
(2) Subcoracoid dislocations,
(3) Subclavicular dislocations,
(4) Subspinous dislocations.

1. In *subglenoid dislocations,* the head of the humerus rests upon the

Fig. 411.—Subcoracoid dislocation.

upper part of the axillary border of the scapula and on the long head of the triceps, which may become lacerated. The capsule is torn at its lower and inner attachment. The circumflex nerve may also be torn or bruised. The muscles attached to the tuberosities are sometimes detached, and occasionally both tuberosities are torn off. The primary position of the head is beneath the glenoid cavity, if the accident is due to a fall upon the outstretched hand or elbow. Subsequently, in consequence of the continuance of the force, or as the result of manipulation, the head of the bone becomes displaced forward and a subcoracoid dislocation occurs. In Kroenlein's statistics of 207 dislocations, 203 were subcoracoid or sub-

glenoid. In 539 dislocations at Saint Thomas' Hospital 499 were either subcoracoid or subglenoid. It is not always easy to differentiate these two positions, and they are often spoken of under the general term of axillary displacements.

(2) *Subcoracoid dislocations.* In these displacements the head of the humerus lies beneath the head of the coracoid process, the great tuberosity rests on the inner and under part of the glenoid cavity, and the axillary vessels and nerves are pushed forward and inward between the subscapularis and pectoralis major. The rent in the capsule is at its lower and inner aspect, and comprises from one-half to three-quarters of its circumference. The anterior upper part is tensely stretched across the

Fig. 412.—Subclavicular dislocation.

glenoid cavity. The deltoid, supraspinatous and infraspinatous are tense. The lower borders of the subscapularis and teres major may be torn (Figs. 410 and 411).

(3) *Subclavicular dislocations.* This variety is very rare. The head of the humerus passes inward and lies under the pectoralis major and upon the second and third ribs. It is considered but an exaggeration of the subcoracoid form. In this dislocation there is usually very considerable injury to the soft parts.

(4) *Subspinous dislocations.* These are also rare. The head of the humerus rests upon the posterior edge of the glenoid cavity, or in the infraspinous fossa. The subscapularis muscle is often torn.

The supracoracoid dislocation is also described, in which the head of the bone is displaced upwards. This dislocation is usually complicated either with fracture of the coracoid or acromion process. In some very rare instances of subglenoid dislocations the arm is thrown upwards in almost the reverse of the usual position (luxatio erecta). In a few cases of subclavicular dislocation the arm has remained in the position of strong abduction (luxatio horizontalis).

SIGNS AND SYMPTOMS OF DISLOCATION AT THE SHOULDER.—The acromion process is prominent, while below this the shoulder is sunken and presents a concave surface. The head of the humerus is absent from its normal position in the glenoid cavity, and is to be felt in the axilla, or

Fig. 413.—Kocher's method of reducing dislocations at the shoulder—first manipulation.

beneath the coracoid process. The elbow is displaced away from the side and cannot be made to touch the chest with the hand upon the opposite shoulder (Dugas' test). Occasionally in subcoracoid dislocations this feat can be accomplished. A ruler can be made to touch both the acromion process and the external condyle (Hamilton's test). This is ordinarily impossible in the normal condition, but can also occur in fractures of the upper end of the humerus.

In dislocations the displaced bone is usually immovably fixed, by the untorn portion of the capsule, in a characteristic position.

SUBCORACOID DISLOCATIONS.

As these, with the subglenoid dislocations, constitute about ninety per cent. of all dislocations of the shoulder, they may be taken as examples. In these dislocations the shoulder is depressed, the arm abducted, the axis of the humerus extends from above, downwards, outwards and backwards. A line extending along the axis of the bone leads into the axilla and not into the glenoid cavity. The anterior wall of the axilla is prominent. The axillary folds are slackened and the acromion process is also prominent. The deltoid descends vertically from the shoulder to meet the slanting humerus, and forms an obtuse angle. The forearm is flexed, pronated and supported by the other hand. The arm is rigid. The axillary circumference is increased about one inch, but the length of the arm is not materially changed.

Fig. 414.—Kocher's method—second manipulation.

In subclavicular dislocations the displacement is simply an increase in degree over the subcoracoid (Fig. 412).

In subspinous dislocations the head of the bone is beneath the spine of the scapula, the elbow is displaced forwards but it can be made to touch the chest wall. The hand is rotated inwards and the forearm thrown across the body. The length of the limb is not materially changed.

Diagnosis.—The distinctive features of a dislocation of the shoulder are, first, the arm is fixed and the elbow is held away from the side; second, the glenoid cavity is empty and the head of the bone can be felt in the axilla; third, the line of axis of the humerus leads to a point internal to the glenoid cavity; fourth, the acromion process is prominent while beneath it the deltoid sinks inwards towards the humerus.

TREATMENT.—An anesthetic is not always necessary for the reduction of this dislocation. In muscular individuals with marked muscular tension, and in very sensitive individuals, an anesthetic will probably be required.

A great variety of methods have been practised in effecting reduction. One of the oldest, and at the same time one of the most efficient, is to place the unbooted heel in the axilla, while the patient is in a reclining position, and then make forcible traction upon the arm in the line of the body, using the heel as a fulcrum to force the head of the bone outward into the glenoid cavity.

Reduction by Outward Traction.—The arm is raised to a right angle with the body, when traction is made with one hand upon the arm, while

Fig. 415. Kocher's method: third manipulation.

with the other hand the scapula is fixed. When more force is required the patient should be in a reclining position; the surgeon may place one unbooted foot against the end of the acromion process and the other against the chest, and then with both hands make traction outwards. When reduction is effected the head of the bone will spring into position with a click which can be distinctly heard. The deformity is reduced, and the arm should be brought down to the side and retained there by a bandage.

In old people outward traction may be attended with some risk of injury to the axillary vessels, if great force is used.

Kocher's Method for Subcoracoid Dislocations.—The patient is seated, the surgeon flexes the forearm to a right angle with the arm, and presses

the elbow against the side (Fig. 413). The arm is now steadily but firmly rotated outwards till the forearm is at a right angle to the body, when marked resistance will be felt (Fig. 414). This manœuvre rolls the head of the humerus outward beneath the acromion. The elbow is now carried forwards to near the middle of the body, with the forearm still abducted (Fig. 415). The forearm is now quickly adducted across the chest and the elbow lowered (Fig. 416). Reduction is often accomplished during the first part of the manipulation, and if not, then adduction is practised and the elbow lowered.

After reduction, a pad should be placed in the axilla and the arm secured to the side for a week or ten days. The patient should be cautioned

Fig. 416.—Kocher's method—fourth manipulation.

not to raise the arm above the head for two or three months for fear of re-dislocating the bone.

DISLOCATIONS COMPLICATED BY FRACTURE OF THE ANATOMICAL OR SURGICAL NECK.

In these cases reduction may be attempted by extension upon the arm, while an assistant endeavors to push the head of the bone into position.

Failing in this, McBurney's method may be practised. The head of the bone is exposed by incision, and a gimlet bored into it, when traction is made on the gimlet in the direction of the joint, while an assistant tries to force the bone into the glenoid cavity. If these efforts are successful, the

wound is closed and the arm dressed as for a fracture of the upper third. If the surgeon's efforts are not successful, the fractured portion should be removed.

LACERATION OF THE AXILLARY ARTERY OR VEIN, PRODUCING A TRAUMATIC ANEURYSM.

This is a most serious accident and requires immediate proximal and distal ligation of the injured vessel. Proximal pressure should be made over the third portion of the subclavian, the pectoral muscles divided, the axilla laid freely open, the clots turned out, and the bleeding vessel secured.

OLD DISLOCATIONS.

The problem here is a serious and difficult one, in consequence of the adhesions between the various structures, and especially because of the adhesions between the capsule and the glenoid cavity. There is considerable liability in these cases of injury to the axillary vessels, if they are markedly atheromatous, and to the nerves. Reduction may be attempted at any time before the end of the sixth month, if the functional condition of the arm is poor, or there is severe pressure neuralgia. Before attempting reduction the adhesions should be thoroughly broken up and the head of the bone loosened by forcible pronation and supination of the arm. Reduction may be attempted by anyone of the above mentioned methods. Failing in reduction if there are severe pressure symptoms the head of the bone should be removed.

DISLOCATIONS OF THE ELBOW JOINT.

These dislocations are second in frequency to those of the shoulder, and represent from eighteen to twenty-five per cent. of all dislocations. Three-quarters of the dislocations at the elbow occur in males under twenty years of age. A great majority of these displacements are due to indirect violence and occur as the result of falls upon the outstretched hand. Dislocations may also occur as the result of hyper-extension, or forced pronation or supination.

Displacement may occur in either one of four directions:—backwards, inwards, outwards, or forwards.

Backward displacements comprise about fifty per cent. of all dislocations in this situation. In these the injury is usually caused by falls upon the outstretched hand, the forearm being slightly flexed and pronated (Fig. 417).

Pathology.—The radial head rests behind the capitellum, the coranoid process in the olecranon fossa. The anterior part of the capsule is torn, as well as the anterior part of the lateral ligaments. The brachialis anticus muscle is often torn. The median and musculospiral nerves are stretched, and the brachial artery is compressed by the lower end of the humerus. The coranoid process and the internal or external condyle may be fractured.

Symptoms.—The forearm is flexed and slightly abducted. The elbow is flexed, and the olecranon can be felt extending far behind its normal position. The relation of the three bony prominences is changed, the triceps is tense and extends backwards from the humerus to reach the olecranon,

the forearm is shortened, the cup-shaped radial head is absent from its normal position, and can be felt posteriorly.

DIAGNOSIS.—This is made by considering the age of the patient, the method of reception of the injury, the fixity of the elbow in flexion and pronation, and by carefully examining the relation of the bony prominences. It must be constantly kept in mind that a dislocation at the elbow is frequent-

Fig. 417.—Backward dislocation at the elbow joint.

ly complicated with fracture of a condyle or epicondyle.

TREATMENT.—In reduction of a backward dislocation the method of Sir Astley Cooper is probably the best. An anesthetic is not necessary. The patient is seated and the surgeon places one foot upon the chair, and then grasps the forearm and arm, and makes extension over his knee. Reduction is generally readily effected (Fig. 418).

ANTERIOR OR FORWARD DISLOCATION.

This injury is rare but may occur as the result of a fall upon the point of the flexed elbow. The olecranon is usually not fractured but rests upon the front of the trochlear surface. The capsule as well as the lateral ligaments are extensively torn.

SYMPTOMS.—The forearm is usually flexed, although it may be extended. The olecranon is absent posteriorly. The relation of the three bony prominences is changed; the head of the radius is not to be felt in its normal position opposite the capitellum. The posterior and lower surfaces of the humerus can be outlined by palpation, and anteriorly at times the coranoid process and even the sigmoid cavity of the ulna can be made out.

Fig. 418.—Method of reducing a dislocation at the elbow joint.

TREATMENT.—Extension is made over the knee while the surgeon drags the lower end of the humerus forward into position.

OUTWARD DISLOCATIONS.

These are usually caused by a forced abduction, both bones being displaced outwards: the forearm is slightly flexed, pronated and abducted.

The elbow joint is broadened, the internal condyle is unduly prominent, while the external condyle is hidden. The sigmoid cavity usually embraces the capitellum. The radial head is to be felt anterior and external to the external epicondyle. The ulnar nerve is frequently injured and the lateral ligaments are widely torn. The elbow, however, is quite rigidly fixed.

DISLOCATIONS INWARDS.

These are caused by forced adduction of the forearm; the elbow is slightly flexed, and the forearm markedly pronated and adducted. The elbow is widened, the olecranon embraces the internal condyle, the external condyle is prominent, and the head of the radium is absent from the capitellum; the lateral ligaments are severely lacerated and the elbow is fixed.

DIVERGENT DISLOCATIONS.

The ulnar is usually dislocated backwards and the radius forwards. These dislocations may be caused by hyperextension when the forearm is strongly pronated or supinated. Following the dislocation the forearm is slightly flexed and fixed. The radial head is prominent in front of the humerus and absent from the capitellum. The olecranon is prominent posteriorly. The relations of the three bony prominences are changed.

DIAGNOSIS.—This is readily made. The fixed position of the elbow and the absence of crepitation exclude fractures. In the absence of mobility and crepitation with deformity, and a change in the relation of the bony prominences, the indications point very strongly to a dislocation. In fractures the deformity recurs after reduction, in dislocation it does not.

PROGNOSIS.—This is ordinarily good.

TREATMENT.—All of the dislocations at the elbow may be reduced by the Sir Astley Cooper method, that is, by extension over the surgeon's knee, aided by rotation or supination and lateral pressure to force the bones into position.

OLD DISLOCATIONS AT THE ELBOW.

Attempts may be made to reduce old dislocations at the elbow up to the end of the sixth month. The patient should be given an anesthetic and the adhesions broken up under forced extension, flexion and rotation, aided, if necessary, by open incision. If the attempt is not successful and the function of the joint is very much impaired, partial or complete excision of the articulating surfaces may be practised.

DISLOCATIONS OF THE UPPER END OF THE ULNA.

These may be caused by falls upon the hand, or by violence applied to the anterior surface of the elbow. The accident is frequently associated with fracture of the external condyle.

SYMPTOMS.—The forearm is slightly flexed, usually adducted and fixed. The olecranon is prominent posteriorly, and extending up from its tip the tendon of the triceps is readily to be made out.

TREATMENT.—The displacement is reduced by extension upon the forearm. If the external condyle is fractured the arm should be dressed in the acutely flexed position.

DISLOCATION OF THE HEAD OF THE RADIUS.

This dislocation may be forwards, backwards, or outwards. The forward dislocation is the most frequent and is caused by direct or indirect force, or by muscular action.

SYMPTOMS.—In the forward variety the forearm is flexed and slightly abducted. Flexion beyond a right angle is impossible in consequence of the head of the radius impinging against the shaft of the humerus. The head of the bone is absent from its normal position and can be felt in front of the joint. In backward dislocations the head of the bone is situated above and behind the external condyle, and in outward dislocations it is to be felt above and to the outside of the external condyle.

TREATMENT.—Reduction of the head of the radius is usually readily accomplished by extension upon the forearm, aided by rotation and direct pressure upon the head of the bone. Following reduction the arm should be put up in the acutely flexed position.

SUBLUXATION OF THE HEAD OF THE RADIUS.

This is a nursery accident and is usually ascribed to the lifting of a child by the hands, or to the dragging to its feet, usually by one or both hands, of a child that has fallen. It is thought to be a partially downward dislocation of the undeveloped head of the radius from out the orbicular ligament, a portion of which ligament becomes caught between the capitellum and the head of the radius. It is thought by some that it may occasionally be due to a displacement of the radio-ulnar fibro cartilage.

SYMPTOMS.—The child not only cries if the arm is moved, but allows it to hang by its side and will not use it. The forearm is slightly flexed, pronated and fixed. Supination and flexion are painful.

DIAGNOSIS.—On examination nothing abnormal can be detected. The three bony prominences are in relation, there is an absence of deformity and of crepitus. This fact in connection with the helplessnes of the arm, the pain on motion, the age of the patient, and the manner of production of the injury, are sufficient for diagnostic purposes.

TREATMENT.—The arm should be fully extended and supinated. When all the motions of the elbow have been forcibly executed, pain and fixation disappears and the child regains the use of the arm.

DISLOCATIONS OF THE LOWER END OF THE ULNA.

This is frequently associated with fracture of the radius. Displacement may be either forward or backward, and is caused by direct violence, the hand and radius being fixed, or by extreme supination or pronation. The anterior and posterior radio-ulnar and the internal lateral ligaments are torn.

In the dorsal dislocation the ulna projects posteriorly and the styloid process is absent on the palmar surface of the wrist. The hand is adducted and midway between pronation and supination. The wrist is increased in thickness and is fixed. The axis of the ulna is changed.

In palmar dislocations the hand is usually strongly supinated, and on examination the head of the bone is felt projecting into the palm, while it is absent posteriorly.

TREATMENT.—The radius is fixed and extension made upon the hand, which is strongly supinated in the dorsal, and pronated in the palmar, dislocations. At the same time the lower end of the ulna is pushed into position.

DISLOCATIONS OF THE CARPUS.

These are very rare accidents. Injuries which might cause a dislocation of the carpus, usually result in fractures of the lower end of the radius, in consequence of the very strong radio-capsular ligaments. These dislocations occur in one per cent. of the St. Thomas Hospital series. There may be either a forward or backward dislocation of the carpus. The latter is caused by falls upon the outstretched and strongly extended hand, the forward dislocations by falls upon the acutely flexed wrist.

SYMPTOMS.—In backward dislocations a marked transverse prominence can be seen and felt posteriorly. The hand and wrist are on a line posterior to that of the forearm. The lower ends of the radius and ulna and the styloid processes can be felt on the palmar surface of the wrist. Measurements show the length of the radius and ulna to be normal. The wrist is fixed.

FORWARD DISLOCATIONS.

In this variety the radius and ulna project posteriorly while the carpus projects in front. These conditions must be differentiated from Colles' fracture. This is ordinarily readily made out by the fact that in Colles' fracture the injury is above the joint, largely implicates the radius, may be attended with crepitus, and that the joint surfaces are intact.

TREATMENT.—Reduction is readily accomplished by traction and direct pressure upon the displaced carpus. The wrist should then be immobilized for from four to five weeks.

DISLOCATION OF THE CARPAL BONES.

The os magnum has occasionally been displaced backward, producing a rounded prominence beneath the skin posteriorly. It is a rule readily reduced by direct pressure, but is liable to recur.

DISLOCATIONS BACKWARDS OF THE FIRST PHALANX OF THE THUMB.

This is the only phalanx which causes especial difficulty in its reduction. The injury is caused by falls upon the outstretched thumb or by hyperextension. The head of the metacarpal bone is forced through the capsular ligament, which with the sesamoid bones and the flexor brevis pollicis muscle are drawn tightly around its neck. In complete dislocations the anterior parts of the lateral ligaments are ruptured, and the anterior portion of the capsule bearing the sesamoid bones is often stretched across the dorsal neck of the metacarpal bone, and the head of the phalanx, making reduction difficult.

TREATMENT.—In attempts at reduction the phalanx is extended to a right angle with the metacarpal bone, and while in this position its base should be pushed downwards over the head of the metacarpal bone, thus carrying with it the constricting portion of the capsule, relieving the obstruction and effecting reduction.

Fig. 119. Showing ilio-femoral ligament.

DISLOCATIONS OF THE HIP.

ANATOMY.—The bony constituents of the hip are the acetabulum and the globular head of the femur. The acetabulum is an almost hemispherical

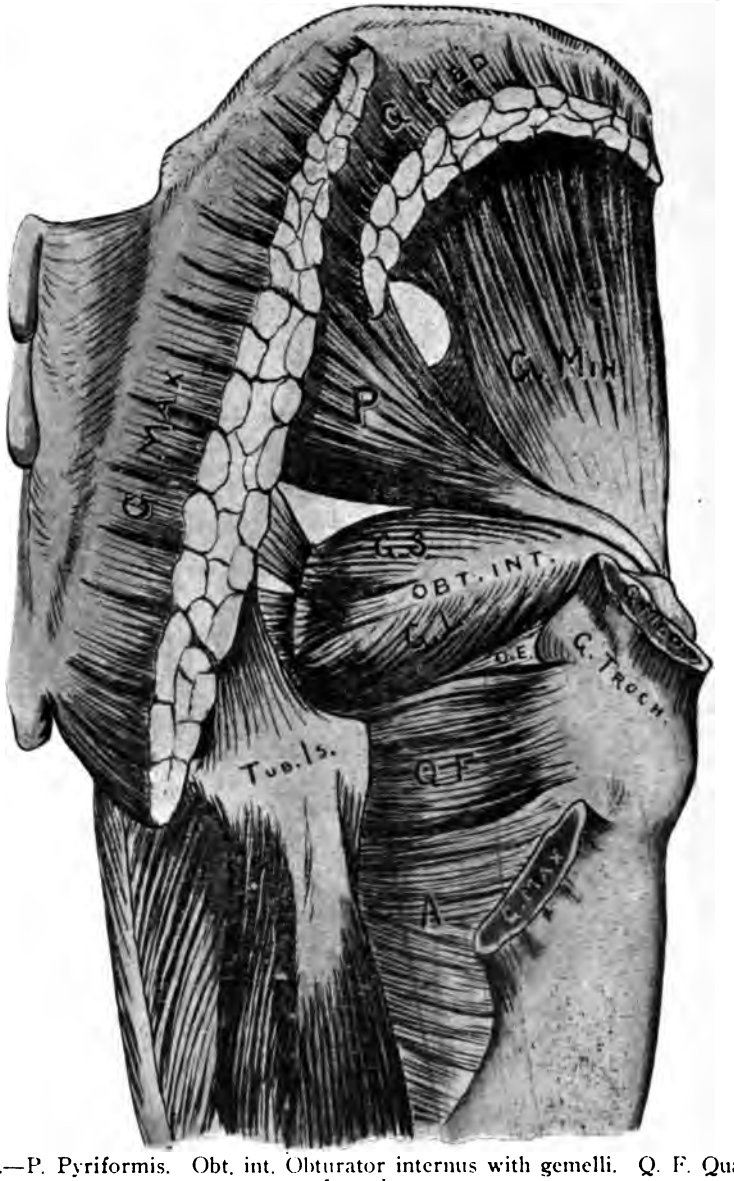


Fig. 420.—P. Pyriformis. Obt. int. Obturator internus with gemelli. Q. F. Quadratus femoris.

cavity, especially strong above and behind but below at the cotyloid notch, deficient for about one inch. The depth of the acetabulum is increased by a fibro-cartilaginous rim, the cotyloid ligament. At the center of the ace-

tabulum there is a circular depression for the attachment of the ligamentum teres. The cotyloid notch transmits the nutrient vessels to the structures of the acetabulum. The head of the femur is a little more than half

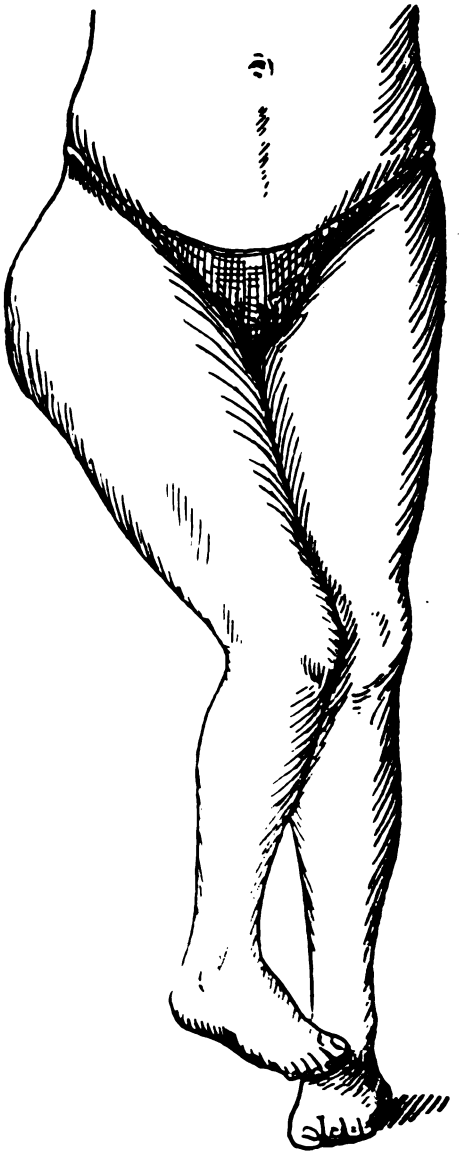


Fig. 421.—Dorsal dislocation

sphere. At its center there is a depression for the attachment of the ...m teres. The capsule of the joint is attached above to the entire ... of the cotyloid cavity—below and in front, to the anterior inter-

trochanteric line—above, to the digital fossa at the root of the great trochanter—behind, to the neck, one-half inch above the posterior inter-trochanteric line, and below the lesser trochanter. The capsule is thickened at some points by accessory ligaments. The most important is the one in front known as the ilio-femoral ligament, or the Y ligament of Bigelow. This is a very strong, fibrous band about a quarter of an inch thick, which has its origin above from the anterior inferior spine of the ilium, and from the adjacent bone, and as its fibers pass downwards, they diverge and form two strong bands. The inner is inserted into the lower part of the anterior inter-trochanteric line, while the outer is inserted into the upper part of the same line. This ligament is one of the strongest in the body. The other ligamentous thickenings of the capsule are known as the pubo-femoral and ischio-femoral ligaments. The former arises from the pubes and the margin of the acetabulum, and is inserted into the anterior and lower part of the capsule. The ischio-femoral ligament arises from the ischium, and is inserted into the posterior portion of the capsule. The muscle of special importance in relation to the hip joint is the obturator internus, which arises from the internal surface of the obturator foramen, passes out of the pelvis through the lesser sacro-sciatic notch, and is inserted with the gemelli into the upper border of the great trochanter. The pyriformis muscle is situated just above the internal oblique and the quadratus femoris below. The muscles about the hip joint check flexion and adduction, while extension and abduction are checked by the ligaments (Fig. 420).

Frequency of Hip-Joint Dislocations.—In 912 cases of dislocations treated at the Pennsylvania hospital, there were 89 (9.75 per cent.) cases of dislocation at the hip. The frequency, however, is ordinarily put down as about two per cent. of all dislocations.

Position of the Limb in Dislocations of the Hip.—The limb is usually strongly adducted, flexed and rotated inwards. Dislocations may also occur by traction upon a strongly abducted limb. In dislocations of the hip the rent in the capsule is as a rule through the posterior and inferior portion, or that portion which is least strengthened by ligamentous bands.

CLASSIFICATION.—Dislocations may be divided into dorsal, sciatic, thyroid and pubic.

Dorsal dislocations are divided into two classes: first, dorsal, and second, everted dorsal. In these dislocations the head of the bone passes over the posterior margin of acetabulum and comes to rest behind and above the cotyloid cavity, or near the great sacro-sciatic notch, or upon the dorsum of the ilium. The head of the bone may pass below the obturator internus muscle, or above this muscle and below the pyriformis, or both muscles may be torn away.

CAUSES.—The dislocation may be caused either by force applied through the flexed, adducted and inwardly rotated limb, or by force applied to the back while the patient is stooping, with the limb in the above stated position. Or the dislocation may be caused by traction on the leg, as when the foot is caught and the patient dragged with the limb strongly abducted and rotated outward. In this variety the head passes below the obturator tendon, the Y ligament is usually torn and the foot is everted and abducted.

Fig. 422.—Dorsal dislocation.

If the dislocation is caused while the limb is flexed, adducted and rotated inwards, the Y ligament is not torn, and it holds the head and neck of the bone closely against the ilium in the same position in which the limb was when the head left the joint.

The backward or dorsal dislocation is readily converted into the iliac by forcing the knee downward, which causes the head to rise upon the ilium.

PATHOLOGY.—In these dislocations the capsule is torn in its lower and posterior part. At times the capsule is torn away from the neck of the femur, and occasionally away from the acetabulum. The ligamentum teres is usually torn from its attachment to the head of the femur, the quadratus femoris and gemelli are usually torn across, the obturator externus and pyriformis are occasionally partially torn, but the obturator internus usually escapes.

SYMPTOMS.—The patient is unable to stand upon or move the limb. If the Y ligament is not torn the thigh is flexed, the knee adducted and the limb rotated inwards with the toes usually resting upon the instep of the uninjured foot (Figs. 421, 422 and 423). The top of the great trochanter is above Nélaton's line and the limb is from one to two inches shorter than its fellow. The distance from the anterior superior spine of the ilium to the top of the great trochanter is increased. The limb can be slightly flexed, still further adducted, but it cannot be abducted or rotated outwards.

DIAGNOSIS.—This is usually readily established. The flexion, inward rotation and adduction, with the fixed position of the limb, are characteristic; and these symptoms are sufficient to differentiate it from fracture of the neck of the femur with its eversion and mobility.

In the rare cases of everted dorsal dislocation the diagnosis is not so easy, but in these the head of the bone can usually be felt upon the dorsum of the ilium, or above the anterior inferior spine of the ilium.

TREATMENT OF BACKWARD DISLOCATIONS BY CIRCUMDUCTION.—The patient is placed upon the floor, or upon a hard mattress, and fully anesthetized so as to relax completely the muscles; an assistant fixes the pelvis to the floor by making firm pressure upon both anterior superior spinous processes of the ilium. The surgeon then grasps the ankle of the dislocated limb with one hand while with the other he grasps the top or under surface of the knee.

Manœuvre 1: The foot and leg are then carried outwards to nearly a right angle with the uninjured leg, while the knee is strongly adducted. This manœuvre relaxes the capsule.

2. While the leg is kept in a strongly abducted position, and the knee adducted, the latter is swung around over the abdomen, with the thigh strongly flexed, to a line perpendicular to the acetabulum (Fig. 424). This brings the head down to the lower and inner part of the acetabulum and to the position of the rent in the capsule.

3. Then by a quick movement the knee is abducted or swung still further outwards, and at the same time the leg is swung inwards to a line perpendicular to the acetabulum, while the leg and thigh are brought down to the straight position. If the last manœuvre is correctly timed it carries the

thigh hangs perpendicularly downward. The sound leg is held by an assistant in a horizontal position, while the surgeon grasps the ankle of the injured member with one hand and flexes the leg upon the thigh. He should then wait until the muscles become relaxed, when the weight of the limb, aided at times by slight downward traction, effects reduction.

If both of these methods fail, which will very rarely be the case, reduction may be made by direct traction.

SCIATIC DISLOCATIONS.

These are dorsal dislocations below the tendon of the obturator internus muscle, the head of the bone being prevented from rising on account

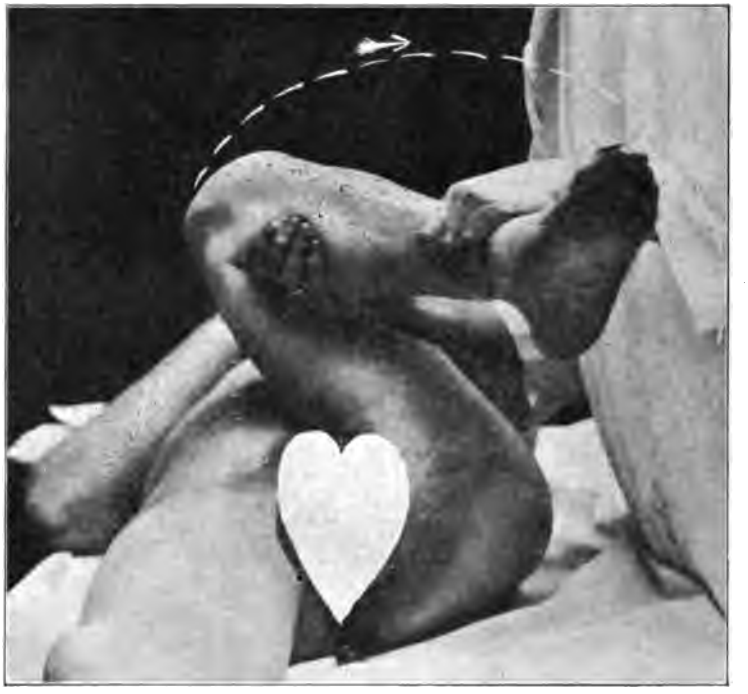


Fig. 424.—First manoeuvre in the reduction of the dorsal dislocation.

of the integrity of the tendon.

The symptoms are practically the same as those in dorsal dislocation, but less pronounced.

Reduction can be effected by circumduction the same as in dorsal dislocations.

EVERTED DORSAL DISLOCATIONS.

Dorsal dislocation may become converted into everted dorsal in consequence of rupture of one or both branches of the Y ligament. In these cases the head rises above and oftentimes in front of the acetabulum. The limb is flexed, everted and abducted.

In the treatment of the everted dorsal dislocation, it is generally necessary to convert it into the dorsal by flexion, adduction of the leg, abduction of the knee and inward rotation. In other words, the maneuvres by which a dorsal dislocation is reduced are reversed.

DISLOCATIONS BACKWARDS AND INWARDS.

THYROID DISLOCATIONS.

In this class of dislocations the head of the bone leaves the socket at its lower and inner part and passes directly downwards into the obturator foramen; or it may pass still further and cross the ischio-pubic ramus and rest in the perineum. These dislocations stand next in order of frequency to dorsal dislocations. The dislocation may be caused by strongly abducting the limb.

Fig. 425.—Thyroid dislocation.

Pathology.—The capsule is torn on its inner and lower side and the ligamentum teres ruptured. The ilio-femoral ligament is untorn. At times the obturator externus and pectineus are torn. The femoral vein has occasionally been ruptured and severe pain is often caused by pressure upon the obturator nerve.

Symptoms.—The limb is flexed, abducted and usually rotated outwards. The trochanteric region is flattened and the trochanter lowered and displaced inwards. The limb is lengthened from one to two inches. The head of the bone can usually be detected in the thyroid foramen or in the perineum (Fig. 425).

PUBIC DISLOCATIONS.

In this variety the head of the bone rests upon the horizontal ramus of the pubes, or on the ilio-pectoneal eminence. The femoral vessels are

pushed inwards, often compressed, and severe pain may be caused by pressure upon the anterior crural nerve. The ligamentum teres and the external rotator muscles, excepting the internal obturator, are usually torn. This

Fig. 426.—Pubic dislocation.

variety of dislocation may be caused by hyperextension or by abduction and downward traction. The capsule is usually torn along its anterior half.

SYMPTOMS.—The hip is flattened and approximated to the middle line. The limb is shortened about one inch, flexed, slightly abducted and everted (Fig. 426).

TREATMENT.—Reduction is usually effected by circumduction in the opposite direction to that which is practised in dorsal dislocations, that is, the foot and leg are adducted, carried across the sound limb, the knee abducted and rotated outwards (Fig. 427). While the leg is maintained in the adducted position the knee is swept outwards and up over the abdomen

Fig. 427. Reduction of hip in pubic or thyroid dislocation—first manipulation.

to a line just internal to that of the acetabulum; when the foot is carried outwards the knee still farther inwards, and the leg brought down straight with its fellow (Fig. 428). Very often in practicing this manœuvre the head of the bone is carried on to the dorsum instead of into the acetabulum. If so the manœuvre for dorsal dislocation is then carried out.

COMPLICATIONS IN DISLOCATIONS OF THE HIP.—Rupture to a greater or less extent of some of the rotatory muscles is probably present in all cases. The greater the amount of injury to the soft parts the longer the confinement to bed and the less perfect the recovery. Consequently in effecting reduction, as little injury as possible should be done to the soft parts. Rupture or injury to the femoral vessels has only been observed in

pubic or obturator dislocations. The injury has usually been followed by the death of the patient. In case of traumatic aneurism of the femoral vessels, proximal and distal pressure should be made, the vessel exposed and double ligated. The sciatic nerve has occasionally been injured, with paralysis of the dependant muscles. In a few cases at autopsy the nerve has been found stretched across the neck of the femur.

DISLOCATION AT THE HIP ASSOCIATED WITH FRACTURE.

Fracture of the head, neck or shaft may occur coincident with dislocation, or may be produced during one's efforts at reduction. Reduction

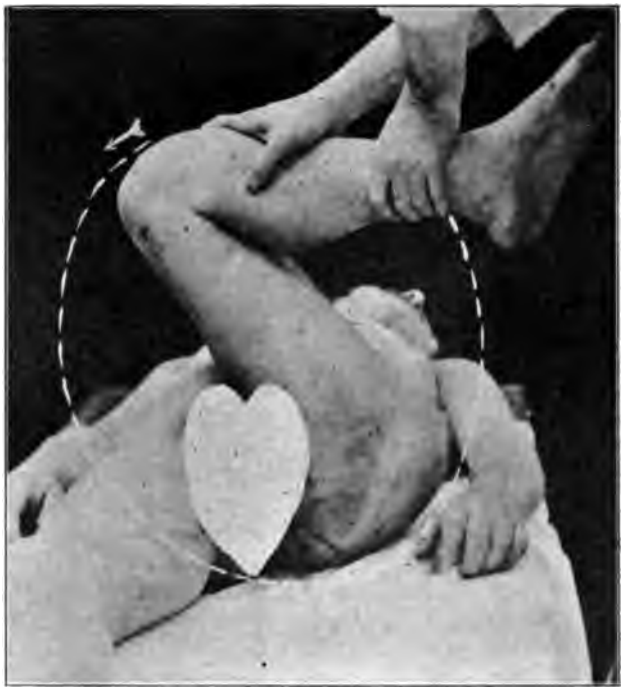


Fig. 428.—Reduction of hip in pubic or thyroid dislocation—second manipulation.

would be difficult or impossible if associated with fracture, and under ordinary conditions if the fracture is situated at the head or neck, excision should be practised and the limb put in the straight position. In fractures of the shaft, healing of the fracture should first be secured and then the dislocation attended to, if thought advisable.

Simultaneous dislocation of both hips has been reported in thirty or forty cases. The cause was usually the reception of a heavy blow or weight upon the back or side while the patient was in a stooping position. The position of the heads of the bones usually differs upon the two sides, one being backwards and upwards and the other downwards and forwards, in

consequence of the patient being twisted half way round during the act of dislocation.

Fracture of the neck and even of the shaft of the femur has occasionally occurred during attempts at reduction.

PROGNOSIS.—After reduction in uncomplicated cases the prognosis is usually good. The patient should be confined to the bed ordinarily for two or three weeks, with the limb extended and everted. Following this he may be allowed to get about for one or two weeks on crutches or with a cane. If reduction is not effected the patient will be permanently lamed. This is largely due to the abnormal position in which the limb is held. The patient may also suffer severe and persistent pain.

TREATMENT OF OLD UNREDUCED DISLOCATIONS.—Reduction may be accomplished by circumduction after the adhesions have been broken up, at any time before the end of the sixth month. Failing in reduction, if the position of the limb is unfavorable and the functional disability great, the head and neck of the bone may be excised. While this procedure produces shortening it gives a very good functional result.

DISLOCATION OF THE KNEE.

Following the usual classification, the tibia is described as being dislocated upon the femur, although it is the latter which ruptures the capsule and causes injury to the soft parts.

Dislocation at the knee comprises only about one per cent. of all dislocations. They are consequently infrequent. This infrequency is due to the large area of bony contact and to the very strong ligaments and tendons which surround the joint.

Dislocations of the knee are divided into forward, backward, inward and outward. They may be compound and are frequently associated with injury to the popliteal vessels or nerves. The vessels may be ruptured or thrombosed from pressure leading to gangrene of the limb. Dislocations are usually incomplete, but they may be complete.

FORWARD DISLOCATIONS.

These dislocations are usually caused by indirect violence, as in hyperextension of the knee, the foot being caught and the person thrown forward. In the complete varieties the tibia lies in front of or above the condyles of the femur. The laceration of the soft parts is excessive.

In the incomplete variety the articulating surfaces of the tibia and femur are still in contact.

The forward dislocation may also be caused by direct violence, as a blow received upon the anterior surfaces of the condyles of the femur, or upon the posterior surface of the tibia.

If the dislocation is compound, the rent in the skin is posterior and usually transverse.

SYMPTOMS.—The knee is usually extended or hyperextended. The head of the tibia is very prominent in front and the condyles of the femur are subcutaneous, behind the popliteal space being obliterated. In the complete variety the limb is shortened from one to four inches; the joint is fixed.

The diagnosis is readily made by inspection and palpation.

TREATMENT.—Reduction is readily accomplished by extension and counter-extension, aided by direct pressure backwards upon the head of the tibia.

BACKWARD DISLOCATIONS.

These are most frequently caused by direct violence, as blows received upon the anterior surface of the head of the tibia, or upon the posterior surface of the condyles of the femur. They may also be caused by falls upon the knee with the leg flexed.

SYMPTOMS.—The leg is usually extended or hyperextended, and, as in the forward dislocations, the antero-posterior diameter of the joint is greatly increased. The condyles project strongly in front and the head of the tibia is prominent in the popliteal space. If the dislocation is complete the limb is shortened.

The diagnosis is readily made on examination.

TREATMENT.—Reduction is effected by extension, counter-extension and direct pressure.

LATERAL DISLOCATIONS.

These are caused by forced abduction, adduction, or rotation. The dislocation is seldom complete. The lateral diameter of the limb is increased. The head of the tibia projects upon one side and the condyles of the femur upon the other. The patella deviates to the side of the head of the tibia. The knee is fixed, the limb extended and rotated outward in the outward dislocations, and inwards when the dislocation is inward. The lateral ligaments are usually ruptured.

TREATMENT.—Reduction is effected by traction and lateral pressure. In dislocations at the knee the bystanders have usually effected reduction by traction before the arrival of the surgeon.

PROGNOSIS.—Permanent weakness and a loose joint favoring redislocation or chronic inflammation are frequent factors following dislocation of the knee. Gangrene of the limb may also occur in consequence of injury to the popliteal vessels. Following reduction the joint should be immobilized for six weeks by a posterior molded splint, or by a plaster cast. After this a hinged posterior or lateral splint made of sole leather and molded to the thigh and leg, should be worn for from eight to twelve months.

DISLOCATIONS OF THE UPPER END OF THE FIBULA.

This dislocation is rare, but may occur as the result of direct force or muscular action. The displacement may be forwards, backwards or upwards. But four cases of the latter variety have thus far been recorded. In these cases the bone was displaced at the ankle and then driven bodily upwards.

SYMPTOMS.—In the forward and backward dislocations the displacement is readily recognized by the absence of the head of the fibula from its normal position, it being displaced either forward upon the head of the tibia or backwards into the popliteal space.

TREATMENT.—Reduction is effected by direct pressure. The knee should then be immobilized in a plaster of Paris cast and in the straight

position. Redislocation is not infrequent in consequence of the action of the biceps muscle.

DISPLACEMENTS OF THE PATELLA.

Dislocation upward or downward is prevented by the attachments of the quadriceps extensor cruris and its tendon. Lateral displacements, and especially outward displacement, when the limb is in the extended position, may readily occur. The inward inclination of the thigh places the patella at the apex of a triangle which has its base outwards; and to overcome what might be a tendency to outward displacement, the vastus internus has a much more extensive attachment to the knee-cap than has the vastus externus. In flexion the patella sinks deeply into the inter-cotyloid notch, and displacement is prevented by the contraction of the quadriceps, but in extension the patella rides up over the condyles, making lateral displacement more easy. Displacements of the patella comprise from seven to ten per cent. of all dislocations.

CAUSATION.—The patella may be dislocated by falls, the patient striking directly upon the border of the bone, or by muscular action. The bone is most frequently dislocated outwards, but it may be dislocated inwards or rotated upon itself, the edge of the bone resting in the notch between the condyles; or the articulating surface may look forwards.

SYMPTOMS.—The knee is usually partially flexed and fixed. The front of the knee is widened and the patella can be felt in its abnormal position, while a hollow exists over the center of the condyles. In the partial rotary displacement, the knee is extended and the sharp prominnt edge of the patella can be felt in the median line, while hollows exist on each side. The quadriceps is tense.

TREATMENT.—Reduction is effected by extending the knee and making direct pressure upon the patella. The knee should then be fixed by a plaster cast.

DISLOCATIONS OF THE FOOT.

These may be backwards, forwards or possibly upwards. Dislocations inwards or outwards are not possible without rupturing the interior tibio-fibular ligament, or fracture of the external or internal malleolus. Incomplete external dislocation is the rule in Pott's or Dupuytren's fracture, and dislocation inwards of the foot may as the result of forced adduction and inward rotation of the foot, with fracture of the internal malleolus. Both of these conditions have been considered under the head of fractures at the ankle. Upward dislocations may occur as the result of falls upon the foot, with rupture of the inferior tibio-fibular ligament and diastasis of the tibia and fibula.

SYMPTOMS.—The symptoms of upward dislocations would be represented by widening at the ankle joint, separation of the malleoli, shortening of the leg, fixation of the ankle joint and an approximation of the malleoli to the sole of the foot.

TREATMENT.—Reduction has often been difficult apparently in consequence of the astragalus becoming wedged in between the tibia and fibula. Reduction should be effected by extension and counter-extension, with rota-

tion of the foot. After reduction the malleoli should be pressed well together and the foot fixed at a right angle with the leg.

FORWARD AND BACKWARD DISLOCATIONS OF THE FOOT.

These dislocations are very infrequent and comprise only about twenty-five one-hundredths of one per cent. of all dislocations.

BACKWARD DISLOCATIONS.

These may be complete or incomplete.

CAUSES.—Hyperextension of the foot is the most frequent cause, in consequence of which the astragalus slips backwards and becomes fixed behind the articulating surface of the tibia.

The lateral ligaments are lacerated or the external or internal malleolus broken off.

SYMPTOMS.—The foot is extended, the heel projects strongly backwards and the distance from the heel to the malleoli is increased. The fore part of the foot is shortened. The lower end of the tibia projects on the dorsum. The tendo Achilles curves upwards and forwards from the heel, and on each side there are hollows.

TREATMENT.—The knee should be flexed to relax the tendo Achilles, when direct traction forwards is made upon the foot, with pressure backwards upon the lower end of the tibia. After reduction the foot should be immobilized at a right angle with the leg.

DISLOCATIONS FORWARD.

These may be due to hyperflexion or to direct force applied to the anterior surface of the leg near the ankle, or to the heel.

SYMPTOMS.—The foot is moderately extended, the dorsum elongated, and the heel shortened. The malleoli approximate the sole, the tendo Achilles approximates the malleoli, and the astragalus can be traced anteriorly.

TREATMENT.—Reduction can be effected by flexing the knee so as to relax the tendo Achilles, and then making traction downwards and pressure backwards upon the foot while the leg is fixed. Following reduction, the foot should be immobilized in a position at right angles with the leg.

PROGNOSIS.—In dislocations at the ankle reduction is usually readily effected. There is, however, some tendency to recurrence. The joint usually remains tender and stiff for a long time, and permanent impairment of motion is frequent.

SUBASTRAGALOID DISLOCATION.

By this is meant a dislocation of all of the bones of the foot, situated below the astragalus, the latter bone retaining its normal relations with the tibia and fibula.

In 1,207 dislocations at St. Thomas' Hospital, there were six subastragaloid dislocations, or forty-nine one-hundredths of one per cent.

CAUSATION.—Abduction and adduction of the foot under normal conditions occur at the astragalo-calcanean joint; but in violent adduction or abduction, as in falls upon the foot, especially when the latter is fixed, dislocation may be produced.

SYMPTOMS.—In inward dislocations the foot is addu inwards. The inner border is raised, and the head of the a prominent projection upon the outer part of the dorsum. leolus is prominent, the inner hidden, the ankle joint is fi tion possibly to a limited degree, while abduction is impos

OUTWARD DISLOCATIONS.

The foot is abducted and everted, the sole turned ou internal malleolus prominent. The external malleolus is hi of the bone is prominent on the dorsum, near the interna foot. The ankle is fixed.

There may also be a forward or a backward subast tion. In the former the dorsum of the foot is lengthen shortened, while in the latter the reverse holds true. Su locations are frequently compound and often complicated w the neck of the astragalus.

DIAGNOSIS.—The distinguishing features are that th in relation to the malleoli, while the foot is displaced.

PROGNOSIS.—Ordinarily reduction may be accomplishe difficulty. The functional result following reduction is usu

TREATMENT.—Reduction is effected by fixing the leg and then making extension and counter-extension, with upon the displaced foot.

DISLOCATIONS OF THE ASTRAGALUS.

These dislocations occur with about the same frequenc astragaloid dislocations, are caused by great violence, and sociated with rotation. The dislocations are, in the main, f ward. The forward dislocations are described as forwar and forward and inward, and the backward dislocations a inward and backward and outward. The outward and in depend upon the position of the foot at the time the disloca the foot is abducted the displacement is inward, if in ad placement is outwards. Following the wrenching of the its normal position it may become partially or completely rot so that in exaggerated cases the under surface of the bon the articulating surfaces of the tibia, and is placed horizo foot. The dislocations may be complete, incomplete or c

SYMPTOMS.—In forward dislocations the astragalus f projection upon the dorsum of the foot, either to the inner c depending upon the direction of the displacement. The di head of the tibia to the sole of the foot is lessened, the an the malleoli approximate the sole. The foot is deflected direction to that taken by the astragalus. The malleolus up side is hidden, while the opposite malleolus is prominent displacements the foot is extended, the astragalus project or in front of the tendo Achilles, the malleoli approximate distance from the head of the tibia to the sole of the foot ankle is fixed.

DIAGNOSIS.—This will depend upon the presence of the astralagus in an abnormal position as well as the approximation of the malleoli to the sole of the foot, and the fixation of the ankle joint.

PROGNOSIS.—In forward dislocations, in consequence of the pain and the pressure of the displaced bone upon the adjacent structures, the limb is practically useless. In backward dislocation the functional disturbance is not so great.

TREATMENT.—In incomplete or uncomplicated cases reduction may often be effected by extension from the foot and direct pressure upon the displaced bone, the leg at the time being flexed so as to relax the tendo Achilles. Following reduction the ankle should be immobilized in a plaster of Paris cast for from four to six weeks.

In cases in which reduction is impossible the astragalus should be exposed by open incision and removed. The results following excision are very satisfactory.

CHAPTER XX.

SURGICAL AFFECTIONS OF THE MUSCLES, TENDONS AND BURSÆ.

CONTUSION OF MUSCLES.

Muscles may be contused as the result of blows or falls, leading to hæmorrhage, inflammatory extravasation and even rupture of their fibres. The part becomes tender and swollen with pain on contraction of the muscle. The functional disability is often marked and persists for some days.

The treatment should be rest, with hot fomentations, followed by support with compress and bandage. When the acute symptoms have subsided massage is serviceable.

SPRAINS OF MUSCLES.

These often occur as the result of sudden and unexpected muscular contraction, as in falls or violent muscular efforts. The injured muscles are sore, stiff and painful on contraction.

The treatment primarily should be rest, with warm evaporating lotions, the muscles being supported by a compress and bandage. Later massage should be resorted to.

RUPTURE OF MUSCLES.

The rupture of a healthy muscle is a rare accident, but may occur as the result of violent and unexpected contraction. Some portions of the muscles of the calf of the leg are occasionally ruptured when one unexpectedly steps off from a curb and endeavors by violent muscular exertion to prevent himself from falling.

Following protracted and high fevers the muscles are more or less in a state of degeneration. Rupture may occur in these cases from slight exertion. The rectus abdominis, the rectus femoris, the adductors of the thigh, and the calf muscles, are among those most frequently torn.

At the time of rupture the patient experiences a sudden, intense pain at the site of the tear, with a feeling as though something had given away. If the muscle is subcutaneous, a gap with a prominence upon each side, may be felt at the site of the rupture. There is inability to use the muscle and its contraction is attended with severe pain, while swelling and ecchymosis readily occur.

TREATMENT.—The limb should be placed and retained in such position as will completely relax the muscle and tend to approximate the torn ends. A compress should then be applied over the rent, and the limb snugly bandaged. Three or four weeks of rest will be required in order to secure

adequate union. If the muscle is healthy, the ends not readily approximated and the muscle's function important, the rent should be exposed by incision and the torn ends stitched together with interrupted catgut sutures. If the muscle is diseased, as following a long continued fever, open incision and suture are usually contraindicated, as the muscular fibres are too soft to hold the strain of the stitches.

HERNIA OF A MUSCLE.

Ocasionally following operations where a wound has been drained for a considerable time, the divided fascia corresponding to the wound may fail to unite. In these cases, when the underlying muscle contracts, its belly is forced through the opening in the fascia, producing a marked swelling. There is at the same time some pain and a feeling of pronounced weakness at the site of the hernia. Perhaps the most frequent situation of this affection is over the external surface of the thigh, where the vastus externus may protrude through a slit in the tensor vaginæ femoris.

TREATMENT.—A compress and bandage may suffice in the treatment, if the opening in the fascia is small and the muscular contractions unimportant, but as a rule, the slit in the fascia will have to be exposed, freshened and united by interrupted catgut sutures. The limb should then be placed at rest for at least ten days or two weeks.

DISPLACEMENT OF TENDONS.

This accident occasionally occurs, especially where a tendon passes through a fibrous canal at which point its course is markedly changed. The long tendon of the biceps may be displaced from the bicipital groove or the peroneus longus from its situation below and behind the external malleolus. The peroneus longus is most frequently displaced upwards from its position behind the external malleolus. The patient during a severe muscular effort feels something suddenly give way, the feeling being associated with pain and disability. The displacement is followed by localized tenderness, swelling and functional disability. In the case of the peroneus longus the tendon can often be felt as it rides over the lower end of the external malleolus.

TREATMENT.—The tendon, if possible, should be replaced by manipulation, when a compress is applied and secured by a snugly fitting bandage. The ankle should then be immobilized in a plaster cast for three or four weeks. If this treatment does not avail, the tendon may be exposed by incision, replaced within its groove and then held in position with two or three catgut stitches through the structures of the fibrous canal. It has been recommended to divide the tendon subcutaneously, when it cannot be held in its normal groove and then to apply a compress and bandage.

RUPTURE OF TENDONS, OR THE TEARING OF TENDONS FROM THEIR OSSEOUS ATTACHMENTS.

A tendon may be torn through its continunity or at the point of treatment to its muscle or to the bone. Rupture of the tendon occasionally occurs as the result of sudden, violent and unexpected muscular contraction. The patient, at the moment of the accident, feels a sharp, severe

ACUTE SUPPURATIVE MYOSITIS.

This is an extremely rare process. In badly nourished individuals, as well as those who have been subjected to exhausting diseases, a suppurative myositis, with considerable destruction of muscle may occur.

TREATMENT.—This should consist in thoroughly exposing, washing out and draining the infected area and building up the patient.

CHRONIC TUBERCULAR MYOSITIS.

May occur as a secondary process, the primary one being in an adjacent joint or bone.

SYPHILITIC DISEASE OF THE MUSCLE.

This is met with in the tertiary period, and occurs as a diffuse induration, or as a circumscribed gumma. The muscles of the tongue, and the sterno-cleido-mastoid muscle are said to be most frequently implicated.

PARASITIC MYOSITIS.

This may be caused by the trichina spiralis, or by hydatids. Trichina myositis is caused by the ingestion of trichinous pork. After a period of incubation of from seven to ten days the disease becomes manifest by a fever ranging from 102° to 104° F. and by intense pain in the muscles, with some swelling. The affected muscles are also very painful on contraction. Involvement of the muscles of the larynx and those of mastication may lead to difficulty in deglutition. Implication of the intercostal muscles and diaphragm may lead to dyspnœa.

MYOSITIS OSSIFICANS.

In some cases nearly the entire muscular system becomes ossified, producing a general ankylosis, and resulting in the death of the patient. The connective tissue of the muscle is especially transformed, while the muscular fibres undergo atrophy. The cause of the disease is not well understood, but it is thought in some cases to be of rheumatic origin. The process occurs most frequently in young males.

ACUTE SIMPLE TENOSYNOVITIS.

This affection most frequently follows bruises and sprains, and is often seen in connection with the extensor tendons of the hands and fingers. The inflammation is manifested by a puffy, elongated swelling associated with a subjacent tendon. The swelling is tender to the touch and painful on muscular contraction. If the exudate is plastic, there will be a slight crepitus on motion.

In the treatment, a compress moistened with an antiseptic or evaporating lotion should be placed over the part and held in position by a snugly fitting bandage. The extremity should then be immobilized. When the acute symptoms have disappeared massage may be resorted to with motion.

ACUTE SUPPURATIVE TENOSYNOVITIS. WHITLOW OR FELON.

By this is understood an acute pyogenic infection, usually of the palmar surface of the terminal phalanx of the finger—less frequently of the

CHRONIC TUBERCULAR TENOSYNOVITIS.

This may be a primary process or secondary to a tubercular inflammation in a neighboring joint or bone. The process is most frequently seen on the back of the wrist, hands or fingers, although the flexor tendon sheaths are not infrequently implicated. It may also occur in the peroneal tendon sheaths, and in those about the knee joint. When occurring about the wrist, hand or fingers there may be but a single tendon affected, or, as is often the case, many tendons may be implicated. In the latter case there will be several elongated, slightly tender, semi-fluctuant swellings.

The affection occurs in three forms:

1. The fungous form. In this variety there is an outgrowth of granulation tissue from the tendon, which may extend to and cover the tendon.

2. In another form there is a passive effusion into, and a plastic exudate upon, the tendon sheaths. The plastic exudate, in consequence of the forward and backward motion of the tendons, becomes rolled up into small, hard, "rice bodies," or "melon-seed bodies." In these cases the rice bodies can at times be felt, and there is marked crepitus on motion.

3. In a third form there is a pronounced dropsical effusion into the tendon sheath, producing an elongated swelling or swellings which are painless and fluctuant.

CAUSATION.—Chronic tubercular tenosynovitis is due to the presence and growth of the bacilli of tuberculosis. These organisms reach the tendon sheath through the circulation, from tubercular processes in adjacent bones or joints, or through ulcers, wounds or abrasions upon the skin. Chronic tubercular tenosynovitis if left to itself tends to progress in that the process constantly invades new areas of the tendon sheath, and also by continuity of structure implicates adjacent tendon sheaths, and, less frequently, the adjacent soft structures, bones and joints. The process may also go on to suppuration.

DIAGNOSIS.—This will rest upon the following facts: The swellings are spindle-shaped, soft, semi-fluctuant, painless and follow the course of the tendons. They are progressive and any motion of the finger is transmitted in part to the swelling. The affection usually occurs in children and young adults and causes weakness of the part. When the process is situated in the palm of the hand it usually affects several tendon sheaths, and if it extends upward to the wrist, an hour-glass-shaped swelling is produced in consequence of the contraction of the anterior annular ligament. The condition is usually described under the name of compound ganglion of the palm and wrist.

TREATMENT.—The Bier treatment may be practised primarily for an hour each day, that is, the arm or forearm just above or below the elbow is constricted for this length of time by an elastic bandage. The constriction should be sufficient to obstruct the venous return circulation, but not to interfere with the arterial circulation. Consequently a passive hyperemia is produced, and the part filled with blood. Failing in this treatment, the part should be thoroughly asepticized, an Esmarch's bandage applied, the swellings incised, and all the granulation tissue curetted away, or the infected portion of the tendon sheath excised. The wounds are then dusted with iodoform powder and closed by interrupted sutures, and the hand

and wrist immobilized until the wounds have healed. At the same time the patient's health should be improved and he may be given carbonate of guaiacol internally.

EXCITED GANGLION.

This is represented by a round, firm elastic swelling, most frequently situated on the back of the wrist, and in direct relation with a tendon sheath. It usually occurs in young adults and is presumably caused by a strain. Anatomically, the sheath of the tendon at some circumscribed area is dilated, forming a sac, perhaps as large as a hazel-nut, and containing a thick, glairy fluid. The sac may be pedunculated, or more or less sessile.

The diagnosis will rest upon the location, and also upon the facts that it is present in a young adult, is round, hard, elastic, distinctly circumscribed, of very slow growth and associated with weakness of the corresponding tendon. The growth never reaches any considerable size and is slightly influenced in its position by flexion and extension of the fingers.

The sac can usually be ruptured by making very strong pressure upon it with the thumb while the wrist is flexed, or striking it forcibly with a book. Occasionally after the rupture which is followed by a compress and bandage, the ganglion does not return, as it becomes obliterated by the adhesion of its surfaces. As a rule, however, it will return in these cases. If the ganglion is unsightly and giving rise to considerable functional disturbance, it may be excised. In carrying out excision the parts should be thoroughly asepticized and if thought best an Esmarch's bandage applied and the skin overlying the ganglion and the tissues at its base infiltrated with a solution of cocaine or with Schleich's solution. An incision is then made through the skin and superficial fascia, corresponding in direction with the tendon. The wound is retracted and the tissues separated from the base of the ganglion by blunt dissection. When the base is fully exposed the ganglion is cut away with a pair of scissors. This exposes at the bottom of the wound the tendon, there being a gap now in the sheath. The skin wound is then closed without drainage. The cure is complete and the former weakness of the tendon disappears.

INJURIES AND DISEASES OF THE BURSAE.

The bursæ are closed synovial sacs developed for the purpose of reducing friction between the skin, tendons or muscles, and bony prominences, as for instance the prepatellar, olecranon and thecal bursæ.

In consequence of their exposed position bursæ are frequently injured. The injury may result in hyperemia, inflammatory exudate, pain and swelling.

The treatment should be rest and the application of cold. In the case of a punctured wound of a bursa, followed by infection, the bursa should be freely incised and perfectly drained. It must not be forgotten that the bursa which is situated near the joint, not infrequently communicates with the joint cavity.

DISEASE OF BURSAE. ACUTE BURSITIS.

This may be the result of an injury, of excessive muscular exertion, or of infection. It may also ocur from inflammation in an adjacent joint

extending to and implicating the bursa. The synovial lining is hyperemic and the synovial fluid is secreted in excess. The process may end in resolution, in chronic inflammation, or infection and suppuration may occur.

An excellent example of acute bursitis may often be seen in the prepatellar bursa. This bursa frequently becomes inflamed because of repeated traumatisms, and this so often occurs in housewives who do their scrubbing while upon their knees as to be called "housemaid's knee."

In housemaid's knee there is a circumscribed and very prominent swelling, situated directly over the patella. This swelling fluctuates distinctly and is sensitive and painful. The patient is more or less disabled.

TREATMENT.—The patient may with advantage be confined to the bed. A compress saturated with arnica may then be placed over the bursa, covered with absorbent cotton, and held in position by a snugly fitting bandage. Ordinarily in a few days the process will have subsided or else it becomes chronic. If the amount of fluid is excessive the bursa may be aspirated and then firm compression made. If infection occurs and pus forms the bursa should be freely incised, the incision going to the lowest border of the bursa so as to afford good drainage.

CHRONIC BURSITIS.

This may be the consequence of an acute attack, or may be due to repeated traumatisms.

Chronic inflammation of the prepatellar bursa is a very common affection. The process may implicate one or both bursæ.

The usual or most frequent cause is repeated traumatisms, such as are inflicted by kneeling on a hard floor. The process is of frequent occurrence among inmates of convents, monasteries and among laboring women.

Suppuration is a rare complication.

SIGNS.—There is a quite large, globular, distinctly fluctuating tumor, which is situated directly over the patella. The swelling is only slightly sensitive, but it creates a feeling of weakness and discomfort in the limb.

TREATMENT.—Iodine may be applied, and over this a compress and snugly fitting bandage. If this does not bring relief, (and it usually does not) a perpendicular incision about one-half to three-quarters of an inch long should be made, under strict antiseptic precautions, in the center line, and from the lower end of the sac upwards. A drainage tube about one inch long and of the size of a small lead pencil is then introduced and a large dressing applied, which is held in position by a bandage. The drainage tube carries off the secretions from the bursa, while its presence excites sufficient plastic exudate to cause, with the aid of the compress and bandage, the approximation of the adjacent synovial surfaces, adhesion of and obliteration of the sac. The tube should be left in place for three or four days.

BURSAE THAT ARE FREQUENTLY AFFECTED.

The prepatellar bursa, situated over the patella, is probably more frequently affected than are all the other bursæ in the body combined.

The bursa over the tubercle of the tibia is also occasionally enlarged. The bursa beneath the ligamentum patellæ is not infrequently enlarged

and shows a bulging on each side of the ligament when the leg is flexed. Aspiration of either of these bursæ may be practised and frequently with success.

The bursa beneath the quadriceps extensor tendon is very large and usually communicates with the cavity of the knee joint.

The bursa between the tendon of the semimembranosus and the head of the gastrocnemius is occasionally enlarged. This bursa is situated along the inner border of the popliteal space.

The bursa over the olecranon and the one between the triceps and the top of the olecranon, and the subdeltoid bursa, are also not infrequently affected.

The subgluteal, the bursa over the tuber ischii, known as coachman's bursa, the bursa between the iliacus tendon and the capsule of the hip joint, and the bursa over the os calcis and beneath the tendo Achilles are also occasionally enlarged.

BUNION.

This term is usually applied to an enlargement of the bursa over the metatarso-phalangeal joint of the great toe. The condition is usually associated with enlargement of the joint and an outward displacement of the toe [illegible]. The development of the bunion and the displacement of the toe are usually due to one and the same cause, namely the wearing of too tight or too short shoes, in consequence of which undue pressure is [illegible] on the joint, and the toes crowded together.

[illegible] is the cause of more or less pain and disability. It frequently [illegible] and is liable to infection followed by suppuration. In [illegible] the pain and disability are greatly increased. If suppuration occurs the pus may break through the skin and be discharged externally, or the pus may find its way into the subcutaneous tissue, or into the joint.

Treatment.—The first consideration in the treatment is to provide shoes sufficiently roomy so that all pressure is removed from the joint. Apart from this if the bursa is inflamed it may be painted with tincture of iodine, or ice or a warm antiseptic compress may be applied. If suppuration occurs a free incision should be made and the cavity thoroughly washed out and drained. If the joint is infected it should be resected, or the toe

CHAPTER XXI.

SURGICAL AFFECTIONS OF THE JOINTS.

ACUTE SYNOVITIS.

By this is meant an acute inflammation confined to the synovial membrane of a joint.

The causes are various and may be divided into local and constitutional. Among the local causes may be mentioned cold and dampness, floating cartilages, and incised or punctured wounds. The constitutional conditions leading to acute synovitis are rheumatism, syphilis, pyemia, gonorrhea and disturbances of innervation. In both the local and constitutional disease the process, while involving perhaps primarily the synovial membrane, usually progresses and envelopes all of the structures of the joint, producing an arthritis which may be suppurative or non-suppurative.

PATHOLOGICAL ANATOMY.—The process begins with hyperemia followed by a plastic exudate within and upon the synovial membrane, and an effusion of synovial fluid within the joint cavity. The endothelial cells lining the synovial membrane proliferate and are cast off. These cells with the plastic exudate render the fluid turbid or milky in appearance. If the process goes on to recovery the exudate, both serous and plastic, are absorbed. The membrane will be thickened for a time and there may be adhesions within its folds.

SYMPTOMS.—The joint is not only painful, but the pain is increased on the slightest motion. The joint cavity is distended and the joint swollen. The natural grooves about the joint are obliterated, and it assumes a spindle shape. If the amount of serous effusion is considerable, there will be fluctuation. In consequence of muscular contraction the joint is fixed in that position in which it will accommodate the greatest amount of fluid. This position at the knee and elbow is one of flexion. At the ankle the foot is extended. The joint is also fixed by muscular contraction for the purpose of preventing pain. The constitutional symptoms may be mild or pronounced. There is usually fever and there may be chills.

TREATMENT.—The patient, if necessary, should be anesthetized and the limb straightened, that is, placed in the position in which it would be most useful should ankylosis occur. The joint should then be enveloped in a layer of absorbent cotton and a firm bandage applied, and over this a plaster cast or other suitable splint. When the acute symptoms have subsided the cast may be removed, the joint gently exercised and the limb massaged. If thought best, the cast may be reapplied and held in place by a bandage, or the joint may be simply supported by a compress and bandage.

of the hydrolic ...

sive. The joint becomes filled with pus, which bursts the capsule and reaches the surface directly or circuitously, traveling, it may be, along the anatomical planes, up or down the limb. The process is intensely painful, and with destruction of the articulating cartilages there are starting pains in the limb when the patient endeavors to sleep. While awake the limb is fixed and the joint immobilized by the tonic contraction of the muscles, but when the patient drops off to sleep these muscles relax, the joint surfaces move slightly upon each other and instantly the muscles contract vigorously, forcing the tender joint surfaces together. The patient awakes with a start, screaming with pain. This sequence of events is often repeated a half dozen times or more before undisturbed sleep is secured. As the result of the infection, high fever, intense pain, insomnia and loss of appetite, the patient soon becomes exhausted.

TERMINATION.—1. Following evacuation of the pus the process may terminate in recovery, with a movable joint. Usually, however, even with the best results, the motions of the joint are considerably restricted.

2. The patient may die from sepsis and exhaustion during the acute stage. Or, if he survives this stage,

3. He may die as the result of chronic suppuration, with its pain, loss of appetite and sleep, hectic fever and chronic toxemia.

PATHOLOGICAL ANATOMY.—The synovial membrane becomes hyperemic and markedly thickened from infiltration. The ligaments are sodden and relaxed, as the result of a plastic exudate into their substance. The cartilages are eroded, disintegrated and destroyed. The peripheral portions are eaten away by the growth of the granulation tissue coming from the altered synovial membrane. The central portions disintegrate as the result of pressure and infection. The cartilage cells proliferate, burst their capsules, and leave punched out openings into which the microörganisms enter, thus aggravating the process. Or the cartilage cells may become vascularized and converted into granulation tissue. Whenever a cartilage becomes perforated, the infection spreads beneath it, separating it from the bone, and causing necrosis, often in the form of large flakes. At the same time the ends of the bones become inflamed, the cancellated structure in part absorbed, and the medulla converted into granulation tissue. All of the structures of the joint become more or less infected, softened and filled with a pyogenic exudate. In the segments of the limb adjacent to the joint, the subcutaneous fat practically disappears and the muscles become greatly atrophied.

TREATMENT.—In cases in which there is doubt about the diagnosis or character of the inflammation, the process may be treated symptomatically for two or three days, or until the cause of the inflammation can be established. This treatment should consist in fixation of the joint and the application of ice. When once the process has been recognized as a progressive pyogenic infection, no time should be lost in thoroughly exploring the recesses of the joint cavity by free incisions. These incisions are to be followed by a thorough washing out of the joint cavity, and perfect drainage. Flushing of the joint should be repeated two or three times every twenty-four hours, while in very severe infections constant irrigation may be practised.

ACUTE ARTHRITIS OF SPECIAL JOINTS.

ACUTE ARTHRITIS OF THE SHOULDER.

This is comparatively a rare affection, but may occur from penetrating wounds, in pyemia and as the result of an infection in the axilla. The joint becomes swollen and its movements very painful. The pus may reach the surface in front of or behind the deltoid, or through the axilla.

In the treatment the joint must be thoroughly drained by free incision. An incision directed downwards from the acromion process is probably the best. In many cases the head of the bone will have to be removed before a cure can be effected, and this ordinarily should be done at the time of the first incision. In doing a resection the epiphyseal line should, if possible, be preserved in children, as the growth of the humerus is principally from its upper end.

ACUTE ARTHRITIS OF THE ELBOW.

In acute arthritis at the elbow perpendicular incisions are made on each side of the olecranon and the joint cavity thoroughly drained. In making the internal incision due consideration must be given to the location of the ulnar nerve. Following the incisions the arm is dressed at a right angle with the hand midway between pronation and supination. In adults excision may be practised at once in severe cases. In children it is best to defer excision, if possible, until adult age, on account of the growth of the bone.

ACUTE ARTHRITIS OF THE WRIST.

Infection may occur at the wrist as the result of accidental wounds, or operations upon tendon sheaths or ganglia.

The treatment consists in free longitudinal incisions, avoiding the tendons, but exposing freely the infected area.

ACUTE ARTHRITIS OF THE HIP.

This may be the consequence of an acute osteomyelitis of the upper portion of the shaft of the femur, which extends into and involves the neck of the bone. It may also follow penetrating wounds or of pyemia. The process is attended with severe pain and high fever. The limb is flexed and everted. If the pus is allowed to accumulate it will perforate the capsule and reach the surface, usually either in front of the neck or behind the great trochanter. The head of the bone may become dislocated, or necrosed and detached.

In the treatment a free incision should be made either in front of or behind the joint. In advanced cases and for the purpose of affording perfect drainage, the head, neck and top of the great trochanter should be resected.

ACUTE ARTHRITIS OF THE KNEE.

This joint is frequently the site of penetrating wounds in consequence of which it becomes infected. It may also become infected in pyemia, gonorrhea, or as the result of operations. The infection is attended with very severe pain, high fever, great swelling, marked fluctuation and fre-

quent chills. The surface of the joint is very tender to the touch, the leg is flexed upon the thigh, and the limb laid upon its outer side. The patient sweats profusely and at an early period becomes greatly exhausted. If the process is allowed to continue, the pus will perforate the capsule and invade the surrounding structures. The patient becomes progressively weaker and is likely to succumb from the high fever, pain, inability to sleep or take food, and septic absorption.

PROGNOSIS.—Punctured wounds of the knee joint followed by infection are, with good reason, greatly feared by the profession; and as a rule unless promptly, energetically and properly treated, end in death.

TREATMENT.—In cases in which the symptoms are not especially severe, the joint may be drained by making lateral incisions on each side above and below the patella, and just in front of the popliteal space, and introducing through-and-through drainage tubes. The joint cavity is then thoroughly irrigated two or three times a day, or constant irrigation may be practised for an hour several times each day. In cases in which the infection is severe and progressive the joint should be completely laid open by a transverse incision extending across the top of the joint from one hamstring tendon to the other. The patella is either divided or removed. The lateral and crucial ligaments are divided and a lateral, perpendicular incision made, freely exposing the bursa beneath the quadriceps. The joint is now laid wide open by flexing the leg to a right angle with the thigh, thoroughly washed out with a mild antiseptic and the joint and bursa beneath the quadriceps lightly packed with iodoform gauze, the limb being held in this flexed position. The dressings are removed and the surfaces thoroughly irrigated two or three times in each twenty-four hours, while in very severe cases constant irrigation may be practised. If the case is taken sufficiently early, there is scarcely any difficulty in controlling the most virulent infection by this method, as the entire joint, with its pockets, is fully exposed. Following this process it is practically impossible to secure any subsequent motion in the joint, the first thought being to save the patient's life, and second to preserve the limb.

When infection is under control and the surfaces of the bone covered with healthy granulations the patient should be anesthetized, the articular cartilages removed and the surfaces of the bone freshened with a curette. The limb is then straightened and the deeper portions of the wound united with buried, chromicized catgut, and the superficial with silkworm gut, provision being made for drainage. Following this a large dressing is placed over the knee and held in position by a bandage; then a posterior splint is applied to retain the limb in extension and to immobilize the knee and secure bony union. The results of this operation are very satisfactory, considering the gravity of the condition.

ACUTE ARTHRITIS OF THE ANKLE.

This joint is seldom the site of acute septic arthritis. The joint is difficult of proper drainage without the removal of one of the malleoli or the astragalus. If the process is not readily controlled an amputation may be necessary.

iodide of potash may be given internally. Locally belladonna ointment with ichthyol may be applied. In especially severe cases chalk stones may be exposed by incision and curetted away; or it may become necessary to resect the joint.

PYEMIC SYNOVITIS.

In case of pyemia a joint, or joints, not infrequently become inflamed in consequence of the lodgement therein of infected emboli.

SYMPTOMS.—The pain is usually not severe, although the joint may rapidly fill with pus.

TREATMENT.—The treatment should consist in early and free incision, and the joint should then be washed out and drained. If untreated disorganization is likely to occur.

ARTHRITIS DURING TYPHOID FEVER.

During or following typhoid fever one or more joints, especially the shoulder and hip, may become inflamed. The process may be attended with little or no pain and slight effusion, or the symptoms may be acute and the effusion pronounced. Suppuration is rare, but may occur. The articular cartilages may be more or less destroyed and the joint become subsequently ankylosed.

In the treatment the hip joint should be protected from dislocation by extension and external rotation. If the amount of effusion in either joint is considerable, it may be aspirated. If suppuration occurs the joint should be incised.

ARTHRITIS DUE TO ONE OF THE ERUPTIVE DISEASES.

Acute inflammation of one or more joints occasionally occurs during the course of one of the exanthematous diseases, scarlet fever, small-pox or measles. The inflammation at times runs a severe course, and is followed by more or less ankylosis. During the acute inflammation the joint should be immobilized and antiseptic compresses or ice applied. If pus forms a free incision should be made. If the process becomes chronic, counter-irritation, massage and local hot air baths may be used.

PNEUMOCOCCAL ARTHRITIS.

During the course of an attack of pneumonia or at other times one or more joints may become inflamed as the result of pneumococcal infection. The process may be an acute or chronic synovitis with effusion, or an arthritis with distension of the joint with pus. The joints of the upper extremity are more frequently inflamed than those of the lower.

The symptoms are those common to inflammations of the joints from other causes.

The treatment consists in immobilization of the joint with incision if suppuration occurs.

GONORRHEAL ARTHRITIS.

During the course of a gonorrhea, either in the male or female, one or more joints may become acutely inflamed. The knee, ankle, wrist and

metacarpo-phalangeal joints are those most frequently involved. The process usually occurs during the decline of a gonorrhea, that is, during the third week, although the infection may occur during any period and involve any joint in the body. The gonococci or their toxins are carried by the circulation from the primary seat of the disease, to the joint, where infection occurs and inflammation follows.

The process is characterized, first, by the presence of gonorrhea, second, by the infection of one or more joints, and third, by the acuteness of the inflammation.

SYMPTOMS AND COURSE.—Usually during the decline of gonorrhea, and often in women following childbirth, or a miscarriage, the patient is suddenly seized with intense pain in the knee, ankle, or joints of the wrist and hand. These joints become swollen, exquisitely tender to the touch, and fixed, the patient not tolerating the slightest motion. The constitutional symptoms are marked. There is high fever, often chills, loss of appetite, inability to sleep, and progressive weakness. The process may be confined to the synovial membranes and form a synovitis, but more frequently all the structures of the joint are involved, constituting an arthritis. The exudate may be serous and distend the capsule; or plastic and lead to numerous adhesions and partial ankylosis; or purulent and cause more or less destruction of the articulation. The muscles of the limb show early and marked atrophy. The inflammation usually continues for several weeks before it can be gotten under control.

DIAGNOSIS.—The patient may deny gonorrheal infection, but the occurrence of an acute arthritis confined to one large or a few small joints, and attended with excruciating pain, should, in the absence of other assignable cause, be considered gonorrheal.

PROGNOSIS.—The affected joints are likely to be stiff for a long time, and partial ankylosis may ensue and become permanent. If mixed infection takes place, destruction of the joint will follow and may necessitate resection.

TREATMENT.—*Treatment of the Gonorrhea.* If there is a stricture this may be dilated, although under ordinary conditions local treatment of the urethra is contraindicated, as the use of injections, or the passage of a sound, is likely to be followed by an aggravation of the joint inflammation. Internally, salol, urotropin or sandalwood oil should be administered. At the same time the patient's diet should be restricted, butcher's meat and stimulants being avoided.

Treatment of the Inflamed Joints.—If the position of the joint is faulty the patient should be anesthetized and correction made so as to secure the most serviceable limb, if ankylosis occurs. The joint or joints inflamed should, after the correction, be covered with a compress and bandage and then immobilized until such time as the acute symptoms have subsided. The Bier treatment may also be practised, an elastic bandage being applied above the joint for half an hour or an hour, night and morning, for the purpose of producing a passive hyperemia. This treatment at times seems to relieve the pain and cut short the course of the inflammation. In persistent and aggravated cases the joint may be opened, washed out with a mild antiseptic solution and drained. During the decline of the

inflammation counter-irritation by means of tincture of iodine, ichthyol, small blisters, or the actual cautery, may be resorted to.

ARTHRITIS DUE TO CYSTITIS.

In old men with enlarged prostate and residual ammoniacal urine, the bladder usually becomes severely involved and the urine constantly loaded with pus. In this class of cases acute inflammation of several of the joints of the extremities frequently occurs. In fact so many of the joints of the extremities become inflamed as to simulate acute articular rheumatism. Salicylates, however, have no effect upon the course of the inflammation. The inflammation of the joints is caused by the absorption of the pyogenic microörganisms, and more especially their toxins, from the bladder, and their implantation within the joints. These patients often suffer several attacks of acute arthritis every year, the attacks continuing for days or weeks, depending on the treatment. The attacks always occur when the cystitis and the amount of pus in the urine are most marked.

TREATMENT.—During an attack urotropin or salol should be given and the bladder washed out each day with an antiseptic solution. Inflammation in the joints will subside as soon as the condition of the bladder is improved. The joints should be enveloped in flannel or wool and kept warm. As soon as the attack has subsided, if the conditions are favorable, the bladder should be drained and the prostate removed.

TUBERCULAR DISEASE OF JOINTS—TUBERCULAR ARTHRITIS. (WHITE SWELLING. STRUMOUS ARTHRITIS.)

The bacilli of tuberculosis are usually either implanted within the epiphyseal ends of the bones, or in the synovial membrane. The bacilli may reach the bone or synovial membrane through the circulation, through an external wound or abrasion, from the periosteum, or from the tendon sheaths or adjacent bursæ. In children the process most frequently is osteal, or commences in the epiphysis and extends from there through the articular cartilage to the joint cavity, while in adults the synovial membrane is frequently first affected.

CAUSES.—The immediate cause is the implantation of the bacilli of Koch in tissues which are favorable to their growth and multiplication. The predisposing causes are an inherited or acquired general or local weakness, and a lessening of the vitality and power of resistance of the tissues. Many patients inherit a predisposition to tuberculosis, in that some one or more of their immediate ancestors have suffered from the disease. Others acquire this predisposition in consequence of poor food, overwork, hæmorrhages, exhausting discharges or bad hygienic surroundings. Local injury and chronic inflammation, by lessening the vitality of the tissues, favor the occurrence of tubercular infection.

PATHOLOGICAL ANATOMY.—When the bacilli of tuberculosis reach the synovial membrane, whether primarily implanted therein, or in the epiphysis, they cause by their growth and multiplication hyperemia from irritation, and the formation of nodules or tubercles. These tubercles are situated within the membrane, and are at first discrete, but subsequently may coalesce and form caseous masses which break down and discharge their contents

into the cavity of the joint. Coincident with the multiplication of the bacilli and the formation of tuberculosis, the synovial membrane becomes thickened, œdematous and finally in part converted into granulation tissue. The fringes of this membrane, formed in part of granulation tissue, spread over and become adherent to the articular cartilages. This granulation tissue grows into and erodes the cartilages, and when they have been perforated it spreads out on the surface of the bone, arresting the nutrition of the cartilages and causing them to become necrosed, often in large flakes. In a similar manner the ends of the bones are invaded and made rough and carious. The hyperemia, inflammatory exudate, formation of tubercules and growth of granulation tissue in severe cases are not confined to the synovial membrane, articular cartilages and ends of the bones, but affect all of the structures of the joint, even the overlying tissues. The capsular and other ligaments become involved, softened and relaxed, making partial or complete dislocation possible. The tendon sheaths, connective tissue, and even skin may become implicated. Fistulæ may form, connecting with the joint cavity and with carious bone. As the result of the inflammation, hyperemia, the inflammatory exudate, erosion of the cartilages, the exfoliation of the endothelial cells lining, the synovial membrane, and the caseation and breaking down of the tubercules, the joint becomes more or less filled with tubercular pus. In cases in which the destruction of tissue is slight, the fluid may be quite clear and serous in character.

Under favorable conditions the course of the disease may be arrested at any stage, and resolution occur.

Symptoms and Clinical History.—Tubercular arthritis is most frequently encountered in childhood and in young adults, although no period of life is entirely exempt. The process usually comes on most insidiously, in a weak, anemic, debilitated individual. It may or may not have been preceded by a trauma. Primarily there will be some limitation of motion, slight pain, scarcely observable swelling, and, if the joint is in one of the lower extremities, commencing lameness. As the infection and inflammation progress, all of these symptoms increase. The pain becomes pronounced, the lameness marked, and the swelling decided. The muscles about the joint are then in a state of contraction, and the joint fixed in the position which gives the greatest ease. The subcutaneous fat above and below the joint disappears and the muscles atrophy. This exaggerates the real swelling and produces a spindle-shaped joint. The skin is not discolored, but slightly tender. If the swelling is pronounced and due to a severe purulent or serous exudate, there will be fluctuation. If the swelling is due in large measure to the formation of granulation tissue, the joint will be doughy and import a sense of semi-fluctuation. In consequence of the hyperemia and pathological changes going on, the affected joint is much warmer than its fellow. During the course of a tubercular arthritis there are frequent exacerbations in which the symptoms become more acute. There is usually a slight evening rise of temperature. The patient has an indifferent appetite, sleeps poorly and loses flesh.

Diagnosis.—This will rest upon the following considerations: A single joint becomes chronically inflamed, but without assignable cause, in a young, anemic, debilitated individual. The inflammation is usually situ-

ated in one of the large joints. The process creeps upon the patient very slowly and muscular atrophy is marked, the joint is spindle-shaped, and there is usually a slight rise of temperature in the afternoon.

PROGNOSIS.—This is always serious, but if the patient is seen early and can be placed under the most favorable surroundings and under proper treatment, the process may be arrested, a cure affected and a movable joint secured. If the patient is not seen early, and the conditions are less favorable, ankylosis or destruction of the joint will occur. A great many of these patients die at or about puberty, as the result of local or general tubercular infection.

TREATMENT.—The patients should be placed under the very best possible hygienic surroundings. They should be kept in the sunlight and open air as much as possible. The appetite, if necessary, should be improved by tonics, and they should be urged to take as much nourishment as is possible, and especially milk and fresh eggs. A quart of milk and two or three raw eggs each day will be a great help to any patient suffering from joint tuberculosis. Fats, such as pork, codliver and olive oil, are also very serviceable. Carbonate of guaiacol may be administered with advantage. The joint implicated should be immobilized, under pressure, and if the articular cartilages are involved extension should be made. If there is hydrops, the joint may be aspirated. If pus is present a clean incision under antiseptic precautions should be made. In addition to immobilization and pressure, injections of iodoform emulsion (ten parts of iodoform, twenty parts of sterilized water, and seventy parts of sterilized glycerin), may be practised in joints when the swelling is made up largely of granulation tissue. From a dram to an ounce of this emulsion may be injected at intervals of one or two weeks.

Bier's Treatment. In all cases of tubercular joints the Bier treatment should be given a fair trial. Its actual value has not perhaps been fully determined, but in many cases it seems to act most beneficially.

Arthrectomy. In cases where the cartilages are partially destroyed, the ends of the bone carious, and pus is present, free incision should be practised, and all of the diseased structures removed by curettement, and the joint subsequently drained. If the destruction of tissue is considerable, excision should be practised.

TUBERCULAR DISEASE OF SPECIAL JOINTS.

The shoulder joint is more frequently affected in adults than in children. The process usually commences in the head of the bone and extends from this point to the synovial membrane. If pus forms it may extend along the bicipital groove, or reach the surface in front or behind the deltoid muscle.

A form of tubercular inflammation known as *caries sicca* is most frequent at the shoulder joint in adults. In this variety there is little or no effusion into the joint, but an overgrowth of granulation tissue which erodes and destroys the head of the bone. The joint is excessively painful, fixed and shrunken. The muscles undergo early and marked atrophy. There is little constitutional disturbance other than weakness. The treatment is usually excision.

TUBERCULAR DISEASE OF THE ELBOW JOINT.

This is frequently the seat of tubercular inflammation, especially in children and young adults. The process is usually osteal in adults, and commences in the olecranon or external condyle. In children it is most frequently synovial. The process, whether synovial or osteal, can usually readily be differentiated by the symptoms, if the case is seen early. In primary synovial infection the entire joint area quickly becomes sensitive and the joint markedly swollen, whereas in osteal infection the pain is confined to the end of the bone, and the periosteum overlying the node and corresponding in size perhaps to the tip of the finger. This area is very sensitive and perhaps swollen. The joint remains free in its motions until such time as the node shall have perforated the articular cartilage and infected the synovial membrane. It is often possible in osteal tuberculosis to locate the node before it has perforated the articular cartilage, by the pain within the bone and circumscribed tenderness of the periosteum. It can also be established by the X-ray. When the diagnosis of osteal tuberculosis is established, an incision should be made down to and through the sensitive area of periosteum. The compact bone is chiseled away, and the cancellated

Fig. 429.—Bones of a resected elbow joint, showing tubercular caries.

structure corresponding to and including the node removed with a curette. The tract is then drained with a wick of iodoform gauze and allowed to close by the formation of granulation tissue. In tubercular inflammation of the elbow joint the arm should be immobilized at a right angle under pressure and passive hyperemia practised according to Bier's method. If the inflammation progresses in spite of this treatment, and especially if pus forms, free incision or resection of the joint should be undertaken. Following resection a functionally good arm is practically always obtained.

TUBERCULAR INFLAMMATION OF THE WRIST.

At the wrist tubercular disease is not infrequent. It is usually diffuse and affects the synovial membranes of several joints as well as a number of the bones. The process may commence in the lower end of the radius, in the overlying tendon sheaths, in the carpus, or in the synovial membranes. The twist becomes fixed, painful and swollen, the latter especially upon the dorsum. If the condition is allowed to progress, fistulæ form upon the dorsum leading from the carious bone (Fig. 429).

TREATMENT.—In the treatment the hand and the wrist should be fixed under pressure and passive hyperemia practised. If the inflammation progresses atypical resection should be resorted to early in the course of the disease. Otherwise amputation may be necessary. In atypical resection the incisions should conform in direction to that of the tendons. If the resection is done early and under favorable conditions it often gives a very useful joint. In less favorable cases the hand will be deformed, weak, flail-like and require support.

TUBERCULAR DISEASE OF THE HIP. (MORBUS COXAE. TUBERCULAR COXITIS.)

This process usually commences in the head of the femur, although in a considerable number of cases it has its origin in the acetabulum. Morbus coxæ is usually a disease of childhood. It may, however, occur in adults or even after middle life.

CLINICAL HISTOLOGY.—*Early Symptoms.* The affection may begin abruptly, but in the great majority of cases its onset is gradual and insidious. The child limps slightly in the morning after getting out of bed, and there is some slight stiffness of the limb. The weight of the body is borne perhaps on the ball of the foot, rather than on the heel. While the child is at play, or in the evening, the lameness may disappear, or is less noticeable than in the morning. In a short time, if the child is examined carefully, it will be seen that although it runs about there is a decided limp. The limb is flexed slightly at the knee, abducted, rotated upwards and seemingly elongated. The pelvis is also slightly tilted toward the affected side. During this stage there is some limitation in the motion of the joint. The adductions are often tense, and full abduction is not possible and is painful. Adduction and flexion may also be limited.

Lameness. At first this is scarcely perceptible, but as the case progresses the lameness becomes marked, and the child is often disinclined to walk.

Pain. During the early course of the disease pain is either slight or absent, but as the disease advances the pain becomes pronounced and is principally felt during the early stages over the internal surface of the knee. This is in consequence of the distribution of the obturator nerve, and it often causes the surgeon to overlook hip-joint disease and to think that there is some pathological process going on in the knee. Later in the course of the disease the pain often becomes very severe and is then situated largely at the hip. In the later stages it is increased by any motion at the joint. In consequence of this pain the child tries to avoid motion of the joint, and while getting into bed, and during other movements, it often lifts and supports the lame leg by placing the foot of the sound leg behind the calf of the other.

Night-Cries. As soon as the articular cartilages are seriously involved, spasmodic muscular contractions occur in the limb as the child is dropping off to sleep. In consequence of the severe pain which these muscular contractions cause, the child awakens with a scream. With involvement of the articular cartilages muscular fixation is pronounced. The

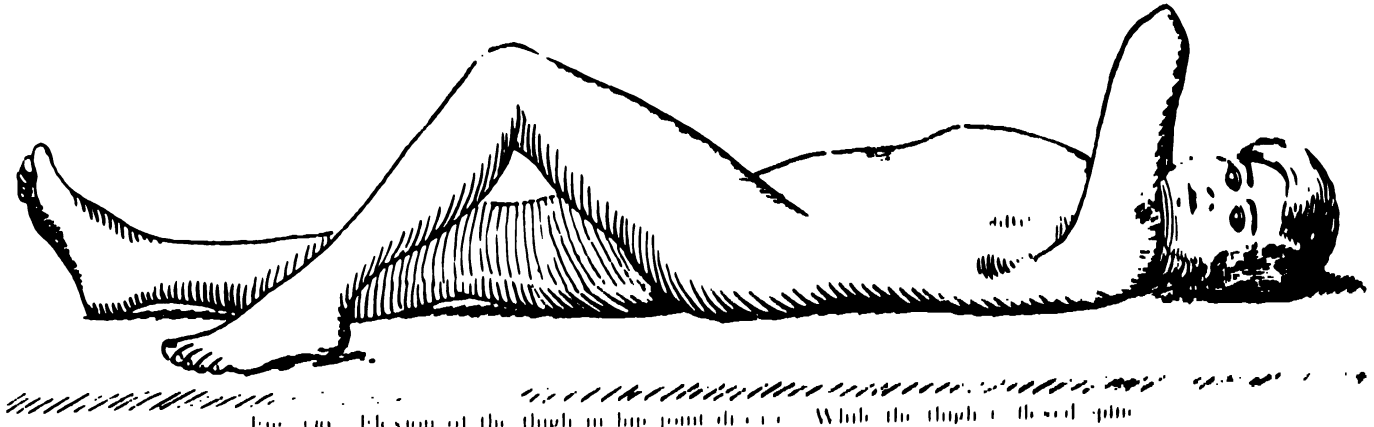


Fig. 430. Flexion of the thigh in hip joint disease. While the thigh is flexed spine approximates the couch.

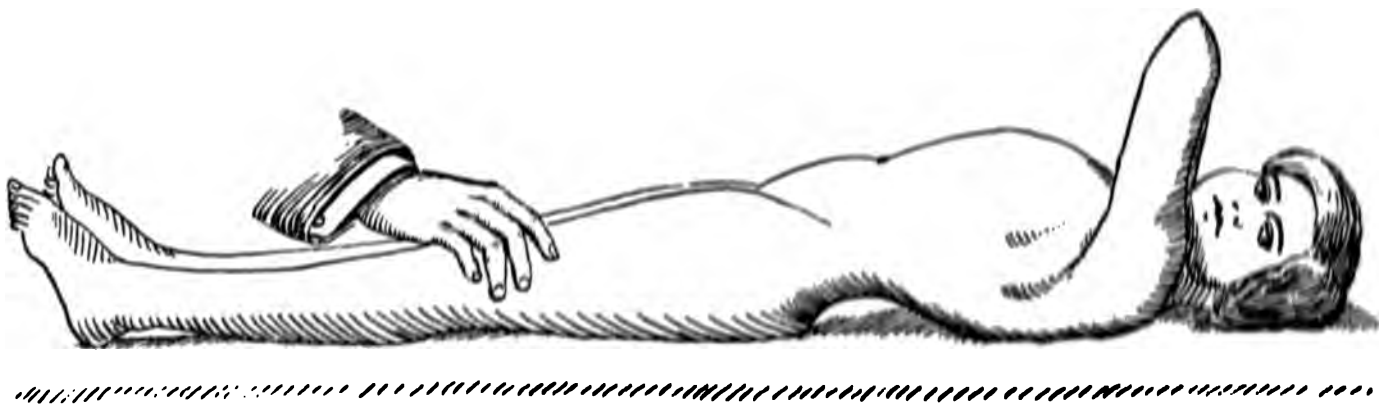


Fig. 431. Hip joint disease showing arching of the spine when thigh is extended.

muscles of the limb, and especially those of the thigh, undergo early and marked atrophy.

Deformity. In the early stage the limb is usually in the position of flexion, abduction and outward rotation. During this stage the leg seems elongated, but later in the course of the disease the limb assumes the position of adduction, inward rotation and is shortened.

Abscess Formation. In a considerable number of cases an abscess forms. This is usually made manifest by the occurrence of a circumscribed and fluctuating swelling situated in front of, or behind, the joint. If the abscess is allowed to go untreated it will open spontaneously. The patient may then seem to improve for a time in consequence of the relief of tension, or may grow markedly worse, as the result of mixed infection.

Shortening. As a result of persistent muscular contraction, the destruction of the head of the bone, and the enlargement of the acetabulum, the limb becomes shortened. The shortening may be but the fraction of an inch, or may be two or three inches.

General Condition. While perhaps primarily the child may seem to be in good physical condition, as the disease progresses it becomes weak, anemic, debilitated and thin in flesh.

Remissions. In the early stages of hip disease there may be frequent remissions, during which the symptoms abate or seemingly disappear. These apparent remissions, however, are of short duration, and are followed by a return or increase of the former symptoms.

Temperature. A child with hip disease usually has some slight rise in temperature during the afternoon. This rise seldom exceeds 100° F.

DIAGNOSIS.—The diagnosis of hip disease will depend upon a careful physical examination and the consideration of the following factors:

Muscular Spasm. Practically in every case of hip joint disease there is some limitation of motion dependent upon muscular spasm. In endeavoring to determine this fact, the child should be placed upon a hard couch or table, and the limb moved with gentleness and care, but in every direction to the fullest extent, that is, in flexion, extension, abduction, adduction, and rotation. If there is muscular spasm, some one or more or perhaps all, of these motions will be restricted and painful. If motion is restricted 10, 25 or 50 per cent. and the limb is carried beyond this point, the pelvis will go with it. In determining the limitations of motion, comparison should always be made with the sound limb. If the limb can be moved to the fullest extent in every direction and without pain, hip-joint disease may be excluded (Figs. 430 and 431).

Lameness. This may be slight and intermittent in the early stages, but is always present. However, as the disease progresses, it becomes more and more pronounced and finally very marked, the child often being unable to walk without the aid of crutches.

Position of the Limb. In consequence of muscular contraction the position of the limb is always changed. The thigh is usually flexed upon the abdomen, and either abducted or adducted, rotated outwards or inwards, and apparently lengthened or actually shortened.

Muscular Atrophy. In all chronic joint diseases the adjacent muscles atrophy. This is especially true of hip-joint disease. The muscles of the

thigh, and to a less extent those of the calf, undergo marked atrophy. The circumference of the thigh is usually an inch or two less than that of the sound limb.

Swelling. There is usually more or less swelling in the joint when the disease is well established. This swelling may be due to the growth of granulation tissue, to serous exudate, or to the formation of pus. If pus forms the swelling is usually pronounced. The swelling is often most marked in front of the neck and at the base of the scarpis triangle.

Pain. During the early course of the disease the pain may be slight or even absent. But as the inflammation progresses the pain becomes pronounced and is situated in the knee joint, on the inside of the knee, or in the hip.

The diagnosis will then rest upon the muscular spasm and fixity of the joint, the lameness, muscular atrophy, position of the limb, swelling and pain.

PROGNOSIS.—The mortality of hip joint disease has been held to be about 30 per cent., while in those who live there usually is more or less deformity, with partial or complete loss of motion. In a very small percentage of the cases a perfect functional result is attained. Two or three years are usually required in the treatment, while the joint may need protection for a year or two longer.

TREATMENT.—In the early stages the patient may be confined to the bed and the joint immobilized, preferably by a Thomas' hip-splint, while sufficient traction is made by weight and pulley to overcome the muscular spasm. If deformity exists the traction must be made in accordance with the axis of the limb. The patient, as soon as the acute symptoms have subsided and the limb has been brought into the straight position, provided abscess formation has not occurred, should be gotten out of bed. At this time the weight and pulley may be exchanged during the day for a long side-traction splint.

Complications. When abscesses form they should be freely incised and drained or aspirated, and injected with an iodoform emulsion. If there is destruction of the head of the bone, pus formation and perhaps fistulæ, resection, atypical or typical, and more or less complete, is required. Atypical resection may be carried out through an anterior incision, the capsule opened and the diseased structures removed; or, complete resection may be done through a posterior incision.

Deformity. If marked angular deformity with bony ankylosis exists, producing practically great shortening and lameness, the femur may be exposed just below the lesser trocanter by a short incision, the bone divided with a sharp bone chisel and the limb straightened and immobilized by fixation in a plaster-of-Paris cast.

TUBERCULAR DISEASE OF THE SACRO-ILIAC JOINT.

Tubercular disease of this joint is infrequent. When occurring the process may, however, have its origin either in the synovial membrane, or in the bone—more frequently in the former.

SYMPTOMS AND COURSE.—There is localized pain and a sense of weakness in the limb. The pain is often referred to the gluteal region, or ex-

·nts of the limb which are transmitted
·atient limps. Any severe contraction of
·g upon the crest of the ilium, causes
by the pressing of the crests of the ilia

·: be differentiated from sciatica and from
·: the nerve is very tender and the pain is
·tion. The sacro-iliac joint is free from

· fixed, the hip-joint cannot be moved to
·muscles about the joint are in a state of
·b is often shortened or apparently length-
·ac joint is free from swelling or tender-
·ests of the ilia together will be without

·the vertebræ are diseased there will be

·re will be pain in the area of distribution
·the affected region. There will ordinarily
·f the limb. The sacro-iliac region will
·and the crowding of the crests of the ilia

· considered unfavorable. Complete re-
·cur during the early stages under proper
·after suppuration has taken place.
·arly stages the treatment should consist in
·is, either with a plaster cast or a Thomas'
·al condition of the patient as much as pos-
·irritation may be resorted to. If pus forms
·sion, and the pus cavity drained. The pus
·ctly over the joint, or it may gravitate into
·per drainage extremely difficult.

·OSIS OF THE KNEE-JOINT.

·ps more frequently affected with tubercular
·the body. The process may commence in the
·wer end of the femur, or upper end of the
· the knee-joint usually occurs in childhood.
·presented by slight interference with motion,
·g and flexion. These symptoms progress in
·t is markedly fixed, swollen and very painful.
·e starting pains during the night. The child in
·d to use a cane or crutches. The joint often fluc-
·indle-shaped. The muscles above and below
·hied, while the skin corresponding to the swell-
·e veins crossing over it here and there (white
· allowed to progress, pus may form and be dis-

[illegible]

[illegible]

[illegible] OF THE [illegible] JOINT

[illegible] synovial membrane [illegible] the astragalus [illegible] primarily situated [illegible] the disease [illegible] involved. With [illegible] markedly swollen [illegible] The joint surface [illegible] tender to the touch [illegible] and more or less [illegible]

[illegible] at a right angle to the leg [illegible] may be resorted to [illegible] disease progresses [illegible] It is usually neces- [illegible]

[illegible] ARTHRITIS [illegible] ARTHRITIS [illegible]

[illegible] quite probable [illegible] have been included [illegible]

[illegible] and anxiety, an ex- [illegible] xication the [illegible] articular rheumatism are among the [illegible] cases the process follows more or [illegible] articular rheumatism. Again it may fol- [illegible] a joint.

[illegible] rheumatoid arthritis into [illegible] the primary. [illegible] The primary form follows, as a cause, gen- [illegible] mental worry, unfavorable hygienic surroundings, [illegible] strenuous use of the joints. The secondary [illegible] articular rheumatism. Max Schiller, Bannetyne and [illegible] a short bacillus which they have isolated from the affected [illegible] and which they think may be the causative factor of the disease.

[illegible] ANATOMY.—The cartilage cells proliferate, the capsules [illegible] and the cells are discharged into the [illegible] The matrix undergoes

fibrillary change, softens, and is worn away, exposing the ends of the bones. These become worn, polished and sclerosed. At the borders of the joint there is an over-production of cartilage, which becomes ossified, producing irregular thickenings, (osteophytes or lippings). The synovial membrane is hyperemic, thickened, and the villi often hypertrophied. These villi may become ossified and later detached, producing loose bodies.

SYMPTOMS AND COURSE.—1. *Chronic Mono-Articular Arthritis.* This form usually follows an injury and is seen in persons past middle life. The joint is painful and creaks on motion. There is little or no swelling, al-

Fig. 432.—Resected ends of tibia and femur, showing tuberculous cavities.

though the ends of the bones enlarge. Limitation of motion is most pronounced after rest, and the pain and stiffness are often increased by changes of weather. The condition often progresses until the joint becomes absolutely useless.

2. *Chronic Poly-Articular Arthritis.* This form most frequently occurs in young girls and in young women. It usually either follows an attack of acute articular rheumatism, or occurs in persons who are anemic and greatly debilitated in consequence of exposure, overwork, and mental

worry, or who are weakened from having had one or more of the infective diseases. The process usually comes on quite abruptly and without assignable cause. The patient experiences severe pain in one or more joints of the hand, in the shoulder or knee. The joint affected becomes swollen and motion is painful. The patient is unable to use the hand, shoulder or knee. If the process begins in a single joint it quickly spreads to others and is often symmetrical. In rheumatoid arthritis there are frequent remissions during which the joints, or some of them, return practically to their normal condition, and then without apparent cause the process recurs more vigorously perhaps than before. In the course of the disease many joints are attacked which subsequently completely recover. The disease in its progress, however, soon becomes permanently fixed upon certain articulations. Frequently these are the small joints of the fingers or the joints of the wrist, and as a rule both hands will be implicated, or both

Fig. 433.—Resected ends of tibia and femur, showing caries and cavities.

knees, ankles or shoulders are affected. In fact any of the joints of the body may become affected, even the tempero-maxillary and vertebral joints. The joints become stiff and quite painful, the ends of the bones enlarged and nodular (Heberden's nodes).

The disease is extremely chronic, but progressive, the patient becoming severely crippled and also bedridden. Constitutionally there are but few symptoms other than general weakness. There may be very slight fever.

3. *Acute Poly-Articular Arthritis.* This form usually attacks young women or girls. The process comes on suddenly with fever and often follows some one of the infectious diseases. The joints of the hands or feet are most frequently involved. Later the process may spread to the larger joints of the extremities, which are usually swollen as the result of a

synovial effusion. At a later stage the ends of the bones become thickened.

The progress of the disease is slow and may become arrested as the result of treatment.

DIAGNOSIS.—The diagnosis of rheumatoid arthritis is usually not difficult. The sudden onset, the chronicity of the process, the number of joints involved, the stiffness, pain, creaking and enlargement of the ends of the bones, present a fairly characteristic picture. Added to this are the further facts that the process usually occurs in young, debilitated, weak, anemic females with wrecked nervous systems. These young women often have been overworked, or perhaps employed in basements, and have had too much care and responsibility. The process may also come on following overwork at school. One very marked characteristic of the disease during its early stages is that it passes from joint to joint, finally settling upon one or more joints permanently.

PROGNOSIS.—This is usually unfavorable. The disease, if once well established, usually progresses until the patient is a helpless cripple. This is especially true if a number of joints are implicated. If the case, however, is seen during the early stages and properly treated, the disease can often be arrested, or even perhaps cured.

TREATMENT.—The patient should give up mental work and be relieved from all care and mental worry. The hygienic surroundings should be faultless and if possible the patient should live in a warm climate, and preferably in the country. The appetite should be improved and as much rest and sleep as possible secured. Cold and dampness are also prejudicial and should be avoided. In the local treatment the joints should be protected by flannel and be exercised, massage at times being beneficial. Mild counter-irritation may also be resorted to. Internally, arsenic, syrup of the iodide of iron, iodide of sodium, and codliver oil may be given. The principles of treatment should be to bring the patient's physical condition up to the highest possible standard.

CHARCOT'S DISEASE. NEUROPATHIC ARTHRITIS.

This disease was first described by Charcot. It is peculiar in that it occurs during the course of locomotor ataxia, and is usually confined to the knee-joint. The hip and shoulder may, however, be implicated. The disease usually comes on suddenly, following, it may be, some slight strain or injury. The joint in a few hours, perhaps overnight, becomes greatly swollen with a serous exudate, and fluctuates markedly. The capsular and other ligaments are softened and very much stretched as the result of the effusion, and the joint surfaces but loosely held in apposition. Because of the relaxation the patient often dislocates his knee on the first attempt to walk.

In the course of the disease there is practically an absence of local heat, tenderness and pain. In some cases the joint surfaces are eroded and worn away, and the ends of the bones atrophied, while in others, (as in Fig. 434) there are great bony outgrowths springing from the borders of the articular cartilages and surrounding the joint. In the patient represented in Fig. 434 there was such an outgrowth as large as a man's hand, taking origin from the head of the tibia. In some cases the effusion

DIAGNOSIS.—This will rest upon the facts that the patient has loco-motor ataxia, that but a single joint is affected, usually the knee, hip or shoulder, that the process comes on suddenly, without pain, local tenderness, heat or general fever, but with marked effusion and looseness of the joint structures.

TREATMENT.—This consists in supporting the joint by a posterior hinged splint, and applying a compress and firm bandage over the joint.

and painful. The cartilages may undergo degenerative changes to some extent, becoming fibrillated, worn, rough and at times converted into fibrous tissue. In some cases the margins of the joint enlarge. Complete recovery may occur, or the joint may be left weak, subject to inflammation, and the site of numerous adhesions.

TREATMENT.—This should consist in immobilizing the articulation under compression. If there is much heat, ice may be applied. When the acute symptoms have subsided massage and passive and active motion are indicated.

LOOSE BODIES IN JOINTS. (FLOATING CARTILAGES.)

These are most frequently found in the knee-joint. The loose bodies are composed, as a rule, of dense cartilage and may be single or multiple, small or large. They may be not larger than a pea, or as large as an English walnut. They are irregular, very hard and have smooth surfaces. The loose bodies are due to a variety of causes. They may occur following an injury, an acute or chronic synovitis or arthritis. They may be formed from a fibrinous exudate, or a bloodclot, or be due to the separation of synovial fringes which have become cartilaginous, or they may be due to a traumatism, in consequence of which stalactites or portions of the articular cartilages become separated. The loose cartilages may be attached by long slender pedicles to the synovial membrane, or they may be quite free in the joint cavity.

SYMPTOMS.—The joint implicated is always the site of a chronic synovitis with effusion. There are also frequent acute exacerbations. The former is due to the irritation of the synovial membrane incident to the presence of foreign bodies, and the latter is caused by the foreign bodies becoming caught between the articular surfaces of the joint. As a result of the chronic inflammation the ligaments frequently become sodden and relaxed. The loose bodies can often be felt during flexion or extension as they float about in the excess of synovial fluid. They appear at the side of the patella and usually along its internal border. If one of the loose bodies becomes caught between the articular surfaces, it causes excruciating pain with locking of the joint. This condition persists for a few moments, or until the foreign body becomes dislodged. During its presence between the surfaces of the joint the patient is unable to move the limb or stand upon the foot. Dislodgement is effected by traction upon the leg and by forced flexion or extension. As soon as the loose body escapes from between the articulating surfaces, the joint becomes unlocked. The process is followed by an acute exacerbation or inflammation.

DIAGNOSIS.—This will be established by the history and symptoms. The patient is usually conscious of the presence of loose bodies in the joint. They appear at the side of the patella during movements, and then disappear within the joint.

TREATMENT.—The only treatment which is of any avail is the removal of the foreign bodies. This is accomplished under strict antiseptic precautions by turning down a horseshoe-shaped flap from over the internal surface of the joint. The flap should be about an inch broad to an inch or an inch and a half long. The free portion of the flap should be taken from

just below the patella. After turning down the flap the limb should be well flexed, and the joint freely opened, so as to expose its interior. Loose bodies that are completely detached are picked out with forceps, and those that are pedunculated should have their pedicles divided close to the synovial membrane. After all of the apparent loose bodies have been removed, every recess of the joint should be explored with a pair of forceps or the finger, so that no loose bodies can escape detection. When the bleeding has been arrested the capsule is closed by interrupted catgut sutures, and the skin with silkworm gut. Drainage is unnecessary. A large compress is placed over the knee-joint, and the limb snugly bandaged. The knee is immobilized by a well-padded posterior splint. After three or four weeks, the splint may be removed and passive and active exercise instituted.

DISPLACEMENT OF THE SEMILUNAR CARTILAGES.

(INTERNAL DERANGEMENT OF THE KNEE-JOINT.)

This may occur when the joint is flexed and forcibly rotated. It usually takes place during severe twists or sprains of the knee, as in running, jumping, or doing athletic sports. The semi-lunar cartilages are relaxed, and move more freely during flexion than during extension. If during flexion the leg is forcibly twisted, one of the cartilages, (usually the internal) may be detached more or less completely from the head of the tibia and from the capsule and lateral ligaments. When one of the cartilages is partially or completely detached, it is readily displaced and may be rolled up upon itself, forced outwards, or into the inter-condyloid notch.

Symptoms.—During a severe twist or strain of the joint the patient feels something give way, and experiences a sudden and sickening pain in the knee. The knee becomes locked and any motion transmitted to it is very painful. By flexion and extension the cartilage becomes unrolled or replaced and the joint unlocked. As a result of the traumatism incident to displacement an acute synovitis with swelling occurs. Under rest the swelling will subside, and the cartilage may reattach itself to the head of the tibia, or the accident may recur again and again. The joint then becomes weak, painful and chronically inflamed.

Diagnosis.—This is usually readily established by the history. The displacement occurs during a severe twist or wrench of the joint. The knee is locked, and the seat of great pain. This pain is usually situated over the internal condyle. There may also be, at the site of the displacement, a considerable node, if the cartilage is displaced outwards, or a depression if it is displaced inwards. The process is likely to recur.

Dislocation of the semilunar cartilage must be differentiated from loose cartilages in the knee-joint, which also produce locking of the joint. But in displacements of the semilunar cartilages there are no loose bodies, and the process always follows a severe twist of the joint. In loose bodies there may have been no injury, and these bodies are readily felt by the patient as they float around in the fluid of the joint.

Treatment.—Replacement is usually effected by the patient, but may have to be done by the surgeon. It can usually be accomplished by forcibly and quickly flexing and extending the joint. Following replacement, the joint should be immobilized and a posterior splint applied while the joint

is in a slightly flexed position. When the acute symptoms have subsided, a plaster of Paris cast should be applied and retained for six weeks. Following this an elastic knee-cap may be worn. If the displacement recurs, the joint should be opened by a horseshoe-shaped incision on the side corresponding to the injury, and the loose cartilage either stitched to the periosteal covering of the head of the tibia, or removed—usually the latter. After removal the capsular ligament and other structures are reunited by tier sutures, and the joint put up in a plaster cast for four weeks. The results following the removal of one of the semilunar cartilages are most satisfactory.

ANKYLOSIS.

By this is understood a condition in which the motions of the joint are partially or completely restricted.

Ankylosis may be divided into true and false, complete and incomplete.

In true ankylosis the pathological changes are situated within the joint, and consist largely of adhesions, fibrous or bony, between the folds of the synovial membrane, or between the articulating structures.

In false ankylosis, the changes are outside of the joint proper, and consist of periarticular thickenings and adhesions, cicatrices due to destruction of the skin, and shortening of the muscles or tendons.

Complete or bony ankylosis is due to the destruction of the articulating cartilages, as occurs in tubercular and acute suppurative processes. In this form motion at the joint is impossible, as the ends of the bones are fused.

In incomplete ankylosis there is some motion at the joint, the restrictions being due to the formation of adhesions and bands between the ends of the bones and between folds of the synovial membrane, or to thickening or contraction of the ligaments.

Causation.—The causes of ankylosis may be summarized as follows:

1. Injuries followed by hemorrhage or a plastic exudate into a joint.

2. Acute and chronic synovitis, with plastic exudate, and the formation of adhesions.

3. Tubercular or suppurative arthritis, with destruction of the articulating cartilages.

4. Fractures into a joint, followed by excessive callus and fibrous adhesions.

5. Continued immobilization of joints, especially in old people.

Treatment.—False ankylosis due to the contraction of cicatrices, may at times be corrected by excision of the cicatrix and skin-grafting. If due to shortening of tendons or muscles, these may be stretched or divided. In true, incomplete or fibrous ankylosis, if the adhesions are not massive, the condition may often be corrected by massage, local application of heat and active motion. Occasionally benefit is derived from forcibly breaking up the adhesions under an anesthetic. As a rule, massive adhesions when broken up are reformed. This is especially true of the shoulder joint, where the scapula readily moves with the arm if there is any considerable resistance at the joint.

In cases of bony ankylosis at the knee, with marked flexion, a V-shaped piece may be removed at the site of the joint, and the limb straightened and immobilized until bony union has occurred.

In bony ankylosis with marked deformity at the hip, an osteotomy may be done below the lesser trochanter, and the limb straightened and immobilized.

In massive, fibrous ankylosis, where the condition is unfavorable, the limb may be straightened under an anesthetic and, if thought best, immobilized.

In ankylosis due to healed tubercular processes, there is great danger of reëstablishing the tubercular process by forcibly breaking up the adhesions. In these cases, and especially at the hip, if the position is faulty, osteotomy is the favorable procedure.

In true ankylosis, where the adhesions are massive or bony, Murphy has popularized a method by which the joint is opened, the adhesions or bony union divided, the joint freely manipulated, and then a portion of an adjacent fascia dissected up and swung into the joint between the articulating surfaces, when the incision is closed. In a case of my own with bony union at the knee-joint in a faulty position, due to a gun-shot injury, I opened the joint by transverse incision, divided with a chisel the bony structures, and swung in a portion of the tensor vaginæ femoris between the surfaces. The wound healed by first intention and the patient when he left the hospital had at least 45 degrees of motion without pain.

METATARSALGIA OR MORTON'S DISEASE.

This is a severe neuralgic affection, or a neuritis, implicating the nerves of a foot, the third and fourth digital nerves being those usually affected.

The condition is caused by severe lateral pressure upon the metatarsophalangeal joints, brought about by crowding the feet into too narrow shoes. As a result of this lateral pressure the digital nerves become pinched between the heads of the metatarsal bones, or between the bones and the sole of the foot; and this pressure causes the nerves to become irritated, inflamed and extremely sensitive. The process usually occurs in young women who wear shoes an inch or an inch and a half narrower than their feet. It may also occur as the result of flat-foot, or as a manifestation of rheumatism or gout.

Symptoms.—The patient suffers a severe, often an intense, aching, boring pain in one or both feet, while the shoes are on. The pain is often so great that the patient is obliged to remove the shoes while in church, in a theater, or even on the street. A few moments after the shoes are off the pain disappears. If lateral pressure is made upon the foot, crowding the heads of the metatarsal bones together severe pain is experienced. If pressure is made with the tip of the finger, or the ring of a key between the third and fourth, or fourth and fifth metatarsal bones, near the heads, excruciating pain is experienced. Metatarsalgia, while felt most severely in the foot, often extends up the leg as far as the knee. The condition can generally be quickly relieved if the patient can be induced to wear broad-toed shoes as wide as the foot. In connection with the correction

such as quinine, iron, nux vomica and arsenic, should
the most aggravated cases it may be necessary to re-
fourth metatarsal bone.

RESECTION OR EXCISION OF JOINTS.

oints is practised for a variety of pathological conditions,
d dislocations, old dislocations in which there is severe
ty, fracture dislocations, comminuted fractures of the head
ne, suppurative and tubercular arthritis, and ankylosis with
e excision of a joint is spoken of as atypical when only the
ures are removed, and typical, when all of the bony struc-
into a joint are removed, together with the capsule and
ts. Resections are also spoken of as subperiosteal, where
n and ligaments are stripped from the ends of the bone, and

ork of this scope it is not feasible to describe in detail the
he various operations for resection.

EXCISION OF THE SHOULDER JOINT.

may be required for tubercular or suppurative arthritis, com-
racture, fractures with dislocations, and in old dislocations with
upon the brachial plexis, producing severe pain, and in dislocations
kylosis has occurred (Fig. 435).

hnic. An incision three or four inches long is made from the front
acromion process directly downwards through the fibres of the
muscle. The wound is deepened and held open by retractors. The
l groove is sought for and opened along its outer border, and the
ndon of the biceps displaced inwards. Some branches of the ante-
ircumflex artery will be divided. The capsule is then opened and
uscular attachment to the tuberosities separated close to the bone,
rving as much of the periosteum as possible. This maneuvre is
nly facilitated by rotating the arm strongly inwards or outwards, in
r to expose the tuberosities. The head of the bone is then thrust
rough the wound by adducting the arm strongly and forcing it upwards
nd outwards. As much of the bone as is diseased is then removed with
e saw. In many cases only the head of the bone need be sacrificed. Not
frequently both, or a part of both, tuberosities may be preserved, the
aw-line extending through or close to the anatomical neck. If the syno-
ial membrane and capsular ligaments are diseased, they should be removed
ith shears curved on the flat, and the joint drained with a tube or a wick
f iodoform gauze. The wound is partially closed with sutures, a pad is
laced between the chest and arm, a large dressing applied and the arm
ecured to the side, the forearm being supported by a sling. After two
r three weeks the arm can be let down and passive and active motion in-
tituted. The functional result after resection of the shoulder joint is
usually good.

EXCISION OF THE ELBOW.

This is most frequently required for tubercular and suppurative arthritis and for ankylosis. An incision from five to six inches long is made over the posterior surface of the arm, extending an equal distance above and below the joint. The incision passes through the middle of the olecranon and triceps muscle, down to the bone. The attachments of the triceps to the olecranon are then separated close to the bone. The tissues, including the ulnar nerve, are lifted out of the groove between the olecranon and internal condyle, and forcibly drawn outwards by a blunt retractor. Care must be exercised not to injure the ulnar nerve, by keeping the

Fig. 435.—Line of incision in resection of the shoulder.

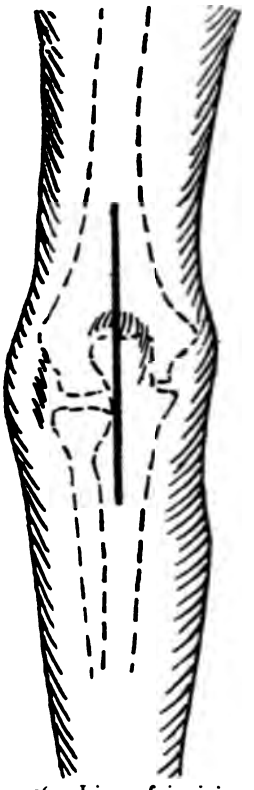


Fig. 436.—Line of incision in resection of the elbow.

periosteal elevator or knife close to the bone. The internal lateral ligaments, and the flexor muscles attached to the internal condyles, are then stripped up with a periosteal elevator, or divided close to the condyle with a knife. The surgeon's attention is then directed to the external condyle, and the external lateral ligament and extensor muscles are separated from the bone. If the posterior ligament has been freely divided the lower end of the humerus can now be pushed into the wound by flexing and making upward pressure upon the arm. The soft tissues on the anterior surface

of the humerus being cleaned away and protected by a gauze retractor, the lower end of the humerus is removed with a saw through the olecranon fossa. The upper ends of the ulna and radius are then pushed strongly into the wound and cleared of the surrounding soft tissues. The head of the radius and the olecranon process of the ulna (the latter including the sigmoid cavity), are then removed with a saw, the soft tissues having been well protected by retractors. The wound is partially sutured, a drainage tube introduced, and the arm supported in a right-angled splint for two or three weeks. Passive motion is commenced during the second week. The functional result is usually most satisfactory (Fig. 436).

RESECTION OF THE WRIST.

The wrist is seldom resected for any other than tubercular disease, and the resection may be typical or atypical.

Operation. The hand and forearm should be rendered bloodless by the application of an Esmarch's bandage, if suppuration has not occurred.

Atypical Resection of the Wrist. The incisions are placed on the dorsal surface. An incision about three inches long, is made just at the radial side of the extensor indicis, reaching to the bone. The tendinous structures on each side of the incision are stripped from the back of the wrist by the use of a periosteal elevator. If necessary an ulnar incision of about the same length is made on the radial side of the extensor carpi ulnaris, and the tendinous structures in this region stripped from the bones. The diseased carpal bones are then removed with cutting forceps, sharp gouges or curettes. The synovial membranes are cut away with shears curved on the flat. The lower ends of the radius and ulna are, if diseased, pushed into the wound and removed. The wounds are partially closed and drained.

COMPLETE OR TYPICAL RESECTION OF THE WRIST—LISTER'S OPERATION MODIFIED.

The radial incision is on the dorsum and corresponds to the one already described. The ulnar incision is placed on the outer side of the ulna between the flexor and extensor carpi ulnaris muscles. Through these incisions all of the tendinous structures on the dorsal and palmar aspects of the wrist are separated from the bones. If not diseased the trapezium and pisiform bones are separated from the rest of the carpus by cutting forceps. The carpus then being quite loose may be removed in its entirety or piecemeal. The ends of the radius and ulna are examined and, if affected, removed. The synovial membranes are also cut away. Following atypical or typical resection, the hand, wrist and forearm should be well supported on a palmar splint.

HIP-JOINT EXCISION.

This joint is frequently excised for tubercular disease. The joint may be readily drained and the head of the bone removed through an anterior incision, commencing below the anterior-superior spinous process of the ilium and extending directly downwards for three or four inches. The incision should be placed just internal to the tensor vaginæ femoris, and

passes between the rectus and gluteal muscles. Some of the muscular branches of the external circumflex artery will be divided. The capsule of the joint is crossed and should be divided on the anterior inter-trochanteric line. By lifting the edges of the wound the capsule can be split up to the head of the bone, and the head and neck explored by the finger. The joint may then be drained through this incision, or the head and neck of the bone removed. Removal can be effected by dividing the neck with a sharp chisel, or a narrow saw, and then either prying it out

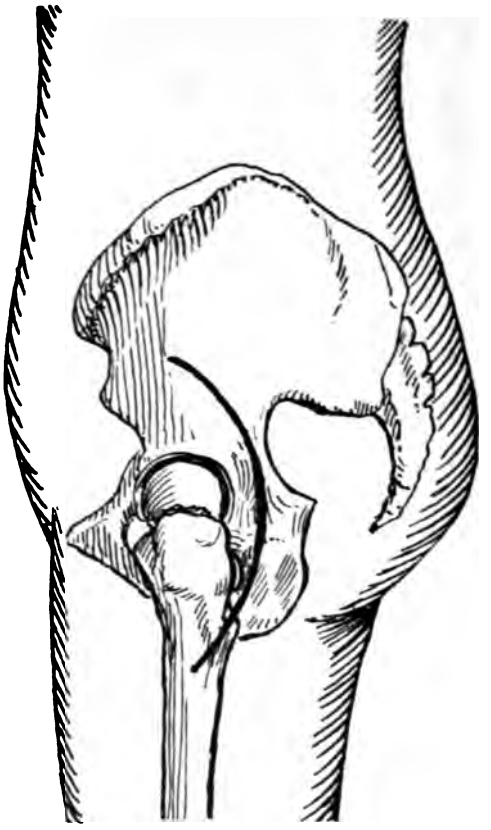


Fig. 437.—Line of incision in resection of the hip.

of the joint with a periosteal elevator, or pressing it out with lion-jawed forceps. For drainage a tube is either introduced, or the wound lightly packed with iodoform gauze.

Resection by Posterior Incision. This is the method usually resorted to. An incision about six inches long is made, commencing three inches above and slightly in front of the great trochanter, and passing down behind the trochanter it terminates over the shaft of the femur. The muscles attached to the great trochanter are divided close to the bone and the

capsule freely opened. Disarticulation is then effected by strongly adducting the thigh and making forcible pressure upwards. The bone is divided with a saw through the greater, and well above the lesser, trochanter. If the acetabulum is diseased it should be curetted out. The synovial membrane and capsular ligament are removed with shears. The extremities of the wound are closed by suture and the center drained. A Thomas' hip splint should be applied, with extension by adhesive straps. The limb will be shortened from two to three inches. Occasionally healing is delayed for a long time in consequence of carious bone, or a tubercularized fistulous tract (Fig. 437).

EXCISION OF KNEE-JOINT.

The knee-joint is principally excised for tubercular disease. It may also be resected for ankylosis when the position is unfavorable.

A transverse incision is made directly across the joint, from the back of one condyle to the other. Either the patella is sawn through or the ligamentum patellæ divided. The leg is flexed to a right angle and the joint freely opened by dividing the lateral and crucial ligaments. The subcrucial pouch is opened by making a short perpendicular incision through the vastus externus muscle. The patella is cut away and all of the synovial membrane removed with a knife or shears. Especial attention should be given to the posterior surface of the joint, the subcrural pouch and the attachments of the synovial membrane, and the periphera of the bones. In removing the articulating surface of the femur the saw should be applied transversely to the articulation and not transversely to the shaft of the femur, as the internal condyle projects downwards further than the external. In sawing the bone from before backwards, the saw should be directed slightly upwards, so that more of the posterior surface is removed than the anterior, and the knee is given a slightly flexed position. The soft parts about the head of the tibia, being protected, the bone is sawn squarely across, only a very thin shell being removed. Any bleeding vessels should be secured by ligation, and the ends of the bones brought together and fixed by passing a strong silver wire through the internal and external condyles and the head of the tibia. External to the wire sutures the bones are still further fixed by uniting with chromicized catgut adjacent portions of the capsule ligaments and fascia. The superficial sutures uniting the skin, are of silkworm gut. The lower angle of the wound on each side is left open, and a wick of iodoform gauze introduced for drainage. The limb (including the pelvis) is then put up in a plaster-of-Paris cast. On the third day fenestra are cut in the sides of the cast over the joint, and the iodoform wicks removed. They are, however, to be replaced by additional wicks until the wounds have closed by the formation of granulation tissue. The cast may be removed, the limb bathed and a new cast applied, at the end of the second or third week. The cast should be worn for about eight weeks, when it may be changed, if the union is good, for a short posterior splint. Barring an inch and a half of shortening and a stiff joint, the results of excision of the knee are most gratifying.

EXCISION OF THE ANKLE JOINT.

This joint is readily reached by two lateral incisions. The one, over the fibula, commencing two inches above the tip of the external malleolus, is carried down its outer surface, and curved backwards around the lower border. The soft tissues, including the external lateral ligament, are separated from the bone, close to the periosteum. The bone is divided about an inch from its lower extremity. The second incision is commenced over the inner surface of the tibia, two inches above the tip of the internal malleolus, and carried downwards to the lower end of the bone, and then forwards for about one inch. The tissues, including the internal lateral ligament, are separated from the internal malleolus and from the bones in front of and behind the joint. By carrying the foot strongly outwards,

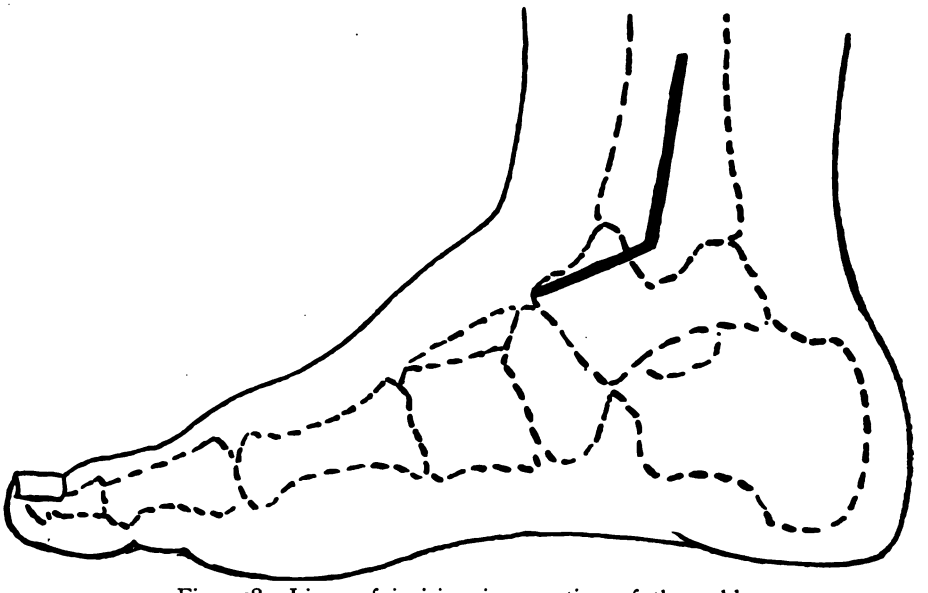


Fig. 438.—Lines of incision in resection of the ankle.

the lower end of the tibia is made to project from the wound, when its articulating surface, including the malleolus, is removed with a narrow saw. The articulating surface of the astragalus is removed through the outer wound, either with a narrow saw or a sharp chisel. The foot is immobilized with a plaster-of-Paris cast, at a right angle to the leg. Fenestra are cut at the sides over the incision, and through these wicks of iodoform gauze for drainage are inserted into the wounds (Figs. 438 and 439).

EXCISION OF THE ASTRAGALUS.

This may be required in tubercular disease, in adhesions, and in some cases of talipes. The bone may be removed through a single anterior incision placed between the dorsalis pedis artery on the outside, and the tendon of the extensor proprius pollicis on the inside. The soft struc-

ures having been separated from the front of the ankle and well retracted, the astragalo-scaphoid and ankle joints are freely opened, and the neck of the bone divided with a bone chisel. The head of the bone is then removed. The connections between the os calcis and the astragalus are divided, and the remaining portion of the bone removed with a chisel, gouge and periosteal elevator.

In cases of dislocation of the astragalus, its connections with the adjacent bones having been ruptured, it may readily be removed by a pair of lion-jawed forceps, after exposure by incision.

EXCISION OF THE TARSUS, EXCLUSIVE OF THE ASTRAGALUS AND OS CALCIS—WATSON'S OPERATION.

Following the application of an Esmarch's bandage an incision is made on the outer side from the middle of the os calcis to the middle of

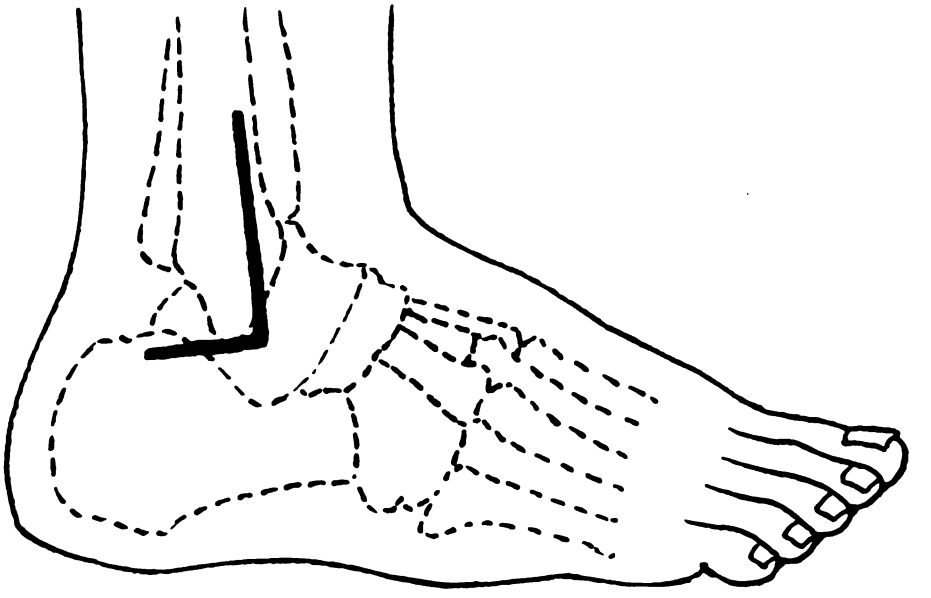


Fig. 439.—Lines of incision in resection of the ankle.

the fifth metatarsal bone, and on the inner side from the neck of the astragalus to the middle of the first metatarsal bone. The soft tissues are then separated from the tarsus on the dorsal and plantar surfaces. The connections between the astragalus and scaphoid, and between the os calcis and cuboid, are divided with a knife. A narrow saw is then passed between the soft structures on the plantar surface and heads of the metatarsal bones, and the latter divided from below upwards. The tarsal bones are then removed and the wounds packed with iodoform gauze. The plantar surface of the foot should be supported by a splint.

In atypical resection of the tarsus a single dorsal incision may be all that will be necessary. This is made over the center of the diseased struc-

ture and parallel with the tendons. The soft structures are separated from the bones and the latter removed with gouge, curette, or cutting forceps. Any portions of the synovial membrane which have become infected should also be removed.

COXA VARA.

This is an affection of the neck of the femur in consequence of which it is bent downwards to a right angle with the shaft and twisted upon itself. The normal angle of the neck is stated to be about 125° to 129°. In coxa vara it is reduced to about 60°. The process is confined almost entirely to young adults.

ETIOLOGY.—But little is positively known concerning the cause. The neck of the bone is softened. Some attribute this condition to a juvenile osteomalacia, others to rickets. Kocher thinks it may be due to prolonged standing. Some think the process is allied to arthritis deformans, while others believe it is due to inflammation of the neck of the bone.

PATHOLOGY.—The neck of the femur is softened (osteoporosis) and bent downwards until it is placed at a right angle with the shaft. With this downward bending there is a posterior or anterior curve, causing either outward or inward rotation of the thigh. The joint is not implicated and infection and pus formation do not occur.

SYMPTOMS.—The condition is progressive for from six to twelve months. During this time there is pain in the hip extending down the thigh. This pain often occurs in paroxysms and is severe. The patient is often quite lame. The limb is adducted, rotated outwards and shortened about one inch. The trochanter major rises above Nélaton's line, there is an absence of fever or other constitutional disturbance, and the functions of the joint are usually unimpaired.

DIAGNOSIS.—The process occurs in young adults and is attended with severe pain, some lameness, shortening of the leg and an elevation of the trochanter. The limb is adducted and rotated inwards. There is an absence of fever. The patient under ordinary conditions is able to be upon his feet. The process is especially to be differentiated from tubercular coxitis in which there is fever, primarily abduction, rotation outwards and apparent lengthening of the limb, with more or less ankylosis and pain upon passive motion imparted to the hip joint.

PROGNOSIS.—Coxa vara runs its course as a rule inside of one year, produces shortening of the limb of about one inch, but does not affect the health or well-being of the patient.

TREATMENT.—During the time of the acute symptoms the patient should be kept off his feet as much as possible. Tonics should be administered. Phosphorus and arsenic are perhaps especially to be recommended.

CHAPTER XXII.

SURGICAL DISEASES OF BONES.

ANATOMICAL CONSIDERATIONS.—Bone is dense connective tissue impregnated with lime salts. It is surrounded by a tough fibrous envelope known as the periosteum. The periosteum is composed of two layers, an outer, coarse fibrous layer, and an inner, much firmer structure composed of fibro-elastic tissue and blood vessels. Underlying the inner layer is the osteogenetic layer, which is intimately associated with the formation of bone through its small round or ovoid cells, known as osteoblasts. The medullary canal and cancellated structure of the long bones, as well as the cancellated structure of the short bones, are filled with bone marrow. The marrow has a delicate connective tissue framework which supports the cells, arterioles, capillaries and venules. The medullary tissue and inner layer of the periosteum are in more or less direct connection through the Haversian system of canals. The marrow is a product of or ingrowth from the osteogenetic layer of the periosteum. The blood supply of a bone is derived from two sources, first, from the nutrient artery which reaches the medulla through a canal in the bone, breaking up into numerous branches, which ramify through the marrow and then extend into the Haversian canals; and, second, from the periosteum from which numerous vessels extend into the bone through Volkmann's canals.

In considering the inflammatory affections of the osseous system it should be remembered that bone is connective tissue which has been impregnated with lime salts; and that such affections only differ from those of the soft parts in consequence of the dense and non-yielding character of the tissues. The inflammatory exudate, if marked and occurring abruptly, may produce such pressure upon the vessels as to arrest the circulation, causing thrombosis and necrosis of bone.

INFLAMMATION OF THE PERIOSTEUM AND BONE.

These affections may be due to a variety of causes such as pyogenic or tubercular infection, injuries, syphilis, the acute infective diseases, such as typhoid and scarlet fever, and the action of local irritants, such as phosphorus or mercury. The inflammatory process may be acute or chronic, localized or diffuse, and end in resolution, more or less destructive of bone, or in the organization of the exudate.

These inflammatory processes may be divided into two main classes: (1) Those directly affecting the periosteum (osteoperiostitis), and (2) those having their origin in the medulla (osteomyelitis).

OSTEOPERIOSTITIS.

This affection usually commences as a periostitis, but rarely remains confined to this membrane, in consequence of the intimate relation between its deeper layer and the superficial portion of the bone.

Osteoperiostitis may be due to a variety of causes, such as wounds, bruises, sprains, pyogenic and tubercular infection, syphilis and chemical irritants.

The inflammation, localized or diffuse, acute or chronic, terminates in resolution, new tissue formation, or in suppuration with destruction of the superficial layers of the bone.

In an acute localized process the periosteum becomes hyperemic and thickened, the vessels entering the bone are drawn upon, compressed and often thrombosed, as the result of a free inflammatory exudate. If the exudate is not infected, the process under favorable conditions will undergo resolution, the hyperemia disappearing, the exudate being resorbed, and the tissues returning to their normal condition. In less favorable cases, and especially where infection has occurred, the periosteum becomes stripped from the bone as the result of a free exudate. The vessels are pulled out of their canals, or thrombosed, and in consequence of the loss of circulation the superficial layers of the bone undergo necrosis. In these cases as soon as an incision has been made and the pus discharged repair will begin. If the shell of dead bone is very small it may be absorbed. If of considerable size it is gradually separated from the living bone by the formation of a layer of granulation tissue. Coincident with this separation the osteogenetic layer of the periosteum forms a new layer of bone to take the place of that which has been destroyed.

SYMPTOMS.—These are localized pain, heat, swelling, tenderness, and redness of the skin if the bone affected is superficial. If the exudates becomes infected there will be constitutional disturbance in the way of fever, loss of appetite, restlessness and an increase of the pain. In infected cases the swelling and pain increase, and after a few days, if the bone is near the surface, fluctuation will make its appearance.

TREATMENT.—Primarily, rest, the elevation of the part, and the application of warm, antiseptic compresses are indicated. The diet should be light and the bowels thoroughly opened. If pus formation occurs a free incision should be made and the wound treated antiseptically. If a shell of bone separates this may ordinarily be picked out of the wound after four or five weeks. Following this the wound readily closes.

ACUTE DIFFUSE OSTEOPERIOSTITIS.

This process is usually due to an injury plus infection. The organisms are pyogenic, virulent, and may reach the surface of the bone either through an open wound or through the circulation. Pus is quickly formed, often in large quantities, and spreads rapidly beneath the periosteum, stripping it from the bone.

A case came under my observation in which the entire shaft of the fibula underwent necrosis in less than a week's time, as the result of an acute diffuse osteoperiostitis. In this case both epiphyses were separated (Fig. 440). The same result may follow an acute diffuse osteomyelitis of the

lus or ulna. With a larger bone, such as the tibia, humerus or femur, nplete necrosis seldom occurs from this process. A fortunate circumnce in this class of cases is that the periosteum is not destroyed and new ne is quickly formed.

SYMPTOMS AND COURSE.—The process is usually ushered in with a chill, llowed by high fever, intense pain in the bone, decided swelling and tenrness. The condition is rapidly progressive. In a few days fluctuation curs and often at the end of a week a great bag of pus has been formed.

TREATMENT.—A very free incision should be made early so as to exose completely and drain the infected area. If acute necrosis occurs and he bone affected is the fibula, radius or ulna, the dead bone should be removed during the second week. The frequent site of an acute or less diffuse osteoperiostitis is the lower and under surface of the femur, where the periosteum is stripped from the lower third of the bone. The frequency of an osteoperiostitis in this position is attributed to strains upon the ligaments in hyperextension of the knee. In these cases in consequence of the deep situation of the pus, the overlying blood vessels, and the proximity of the knee joint incision is often delayed until great mischief has been done to the bone and soft parts. The space outlined by the bifurcation of the linea aspera may, however, readily be reached by an incision commencing just above the external condyle, and anterior to the biceps tendon, and extending upwards for about four inches. The space may also be reached on the inside of the thigh and through an incision situated above the hamstring tendons, the surgeon being careful to keep well above the femoral and popliteal vessels.

Before and coincident with incision the Bier treatment has been practiced with success.

PERIOSTITIS ALBUMINOSA.

This form of periosteal inflammation is rare, but may occur in infants and young children. Circumscribed foci of inflammation not infrequently implicate the periosteum of several bones. There is quite marked swelling, and beneath the periosteum there is an accumulation of fluid, which is thin, turbid and albuminous. There is usually local tenderness, though but little constitutional disturbance. The process has been ascribed to inherited syphilis. It is probably most frequently due to a mild pyogenic or tubercular infection.

TREATMENT.—The treatment should consist in the application of hot antiseptic compresses, and when the acute symptoms have subsided counterirritation may be resorted to. If pus forms an incision should be made.

ACUTE OSTEOMYELITIS (ACUTE NECROSIS).

This affection usually occurs in children and young adults, and often follows severe exertion, the taking of cold, or some slight strain upon or bruise of one of the long bones. The femur or tibia is most frequently affected. The process usually commences in the shaft of the bone near the epiphysis and may be excited in consequence of the strains to which the ends of the bones are subjected by reason of the attachment of the ligaments. The infection commencing in the diaphysis is prevented from reaching the joint in consequence of the close attachment of the epiphyseal cartilage to

the periosteum. The infection is usually due to the staphylococcus pyogenes aureus, or the streptococcus pyogenes, although any one of the pyogenic germs may be the causative factor. The infection usually occurs in

Fig. 440.—Acute diffuse osteoperiostitis following an injury and resulting in complete necrosis of the shaft of the fibula in less than a week.

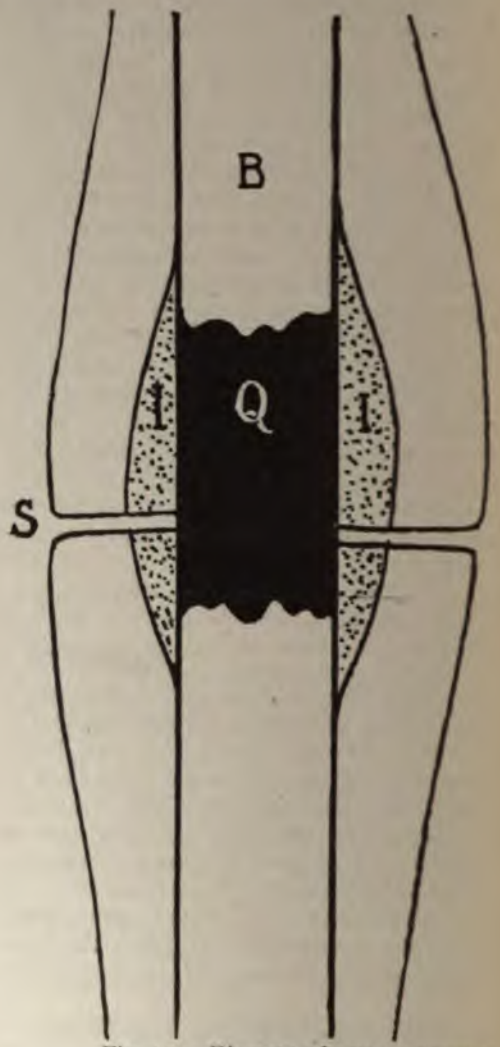


Fig. 441.—Diagram of acute osteomyelitis. B. Bone. Q. Necrosed bone. I. Involucrum. S. Sinus.

a somewhat weakly, debilitated child, with poor resistance, and in whom some one or more varieties of the pyogenic micro-organisms are temporarily circulating in the blood. The child may have had a naso-pharyngeal ca-

tarrh, tonsillitis, gastro-intestinal disturbance, boils, a carbuncle, or seemingly been quite well. Following some slight or perhaps severe injury, overexertion, or taking cold, the germs circulating in the blood become arrested in the marrow, in consequence of the slowness or stasis of the circulation, and finding conditions favorable for their growth, multiply rapidly. If the infection takes place within and extends along the medullary cavity, a typical form of acute osteomyelitis occurs. The marrow becomes intensely hyperemic, its vessels thrombosed, while multiple foci of pus formation occur. As a result of thrombosis of the vessels, the extension of the infection into the Haversian canals and the inflammatory exudate, central necrosis of the bone is produced. If the patient's resistance is considerable, the germs comparatively few, or not especially virulent, the infection becomes localized and implicates only a small section of the marrow. In cases of greater virulence the marrow from one epiphysis to the other may become involved, with necrosis of the entire central portion of the shaft. In any case of acute infection the pus rapidly forms and produces great pressure upon the internal surface of the bone, which it softens and perforates at one or more places, finally reaching the periosteum which it separates more or less completely, causing partial or complete necrosis of the shaft. The pus perforates the periosteum at one or more points and finally reaches the surface, usually by several circuitous routes. The central necrosis corresponds pretty accurately to the area of infection of the marrow, while the peripheral corresponds to the area of separation of the periosteum. With infection of the entire medullary canal and separation of the periosteum, complete necrosis of the bone will occur. Coincident with the death of the bone, whether this be central, peripheral or complete, the osteogenetic or inner layer of the periosteum forms a shell of new bone to take the place of that which has been destroyed. The new bone or osteoid tissue is at first soft, spongy and part of the inner layer of the periosteum, and can readily be stripped from the underlying bone. After three or four weeks it becomes thickened, and, in consequence of the deposit of lime salts, hard and inseparably connected with the underlying bone. This new bone which forms a complete shell about the necrosed area is known as the involucrum. Here and there openings exist known as cloacæ. These are the result of the destruction of the periosteum in circumscribed areas by the escaping pus. The dead bone, known as the sequestrum, becomes separated from the living by linear disintegration of tissue. The chemical products in the dead tissue cause irritation, hyperemia, cellular and plastic exudation in the adjacent living tissue. A progressive line of ulceration separates the dead from the living tissue. From the healthy bone is formed a wall of granulation tissue which assists in separating the dead from the living, and with this separation the sequestrum lies in a bed of granulation tissue. (Figs. 441 and 442).

Symptoms and Course.—In a typical case the child is seized in the middle of the night or during the day, with a terrific and agonizing pain in the thigh, arm or leg. The pain becomes so severe that the child will not allow the limb to be moved or touched. It is fearful even of having the bedclothes arranged or of having a stranger enter the room. A heavy tread upon the floor aggravates the suffering. Almost coincident with the pain

the child may suffer a severe chill, and this is followed by high fever, the temperature often reaching 103° or 104° F. In consequence of the high fever and septic absorption these patients suffer from severe headaches and are often delirious. If the limb is inspected it will seem to be of normal size, shape and color. If it is gently examined no special restrictions of motion will be found, the joints being freely movable. If the bone is palpated there will be marked tenderness, but an absence of swelling. The symptoms and local conditions do not change for three or four days, or until the infection has passed through the bone and attacks the periosteum, when swelling of the soft parts occurs. The swelling soon becomes pronounced and is readily seen and felt. At this time the skin often becomes reddened; and about the end of the first week, or during the second, the pus will have bored its way through the shaft of the bone, usually near the epiphyseal line, and become diffused beneath the periosteum. As the result of this process, the tension within the bone is greatly relieved and the pain may for a time almost disappear. The fever often drops two or three degrees, and the child gets some restful sleep. The pain, however, recurs, but not with the same severity as before, the limb is very tender and the swelling increases. The pus approaches the surface by one or more routes, and finally fluctuation becomes manifest. If an incision is made a great quantity of pus is frequently discharged. With the discharge of the pus the patient is greatly relieved, but the fever does not disappear, and the limb remains swollen, sensitive and painful; the pus continues to be discharged through the fistulous tracts, and the patient is confined to the bed until such time as the dead bone (sequestrum) has been separated from the living. When this separation is complete the tenderness, pain and fever disappear, and the child is anxious to get out of bed, and, if allowed, will walk upon the sore leg.

The time required to separate the sequestrum from the involucrum will depend in a large measure upon the size of the sequestrum and the bone affected. In complete necrosis of a portion of the shaft of the femur, from nine to twelve months will be required in effecting its separation; in the tibia six to nine months; in the radius, ulna and fibula, from three to six months. In extra acute cases in which the entire medulla is infected and the periosteum stripped from the bone, the epiphyses may be acutely inflamed and the entire diaphysis necrosed and separated from its connections in from four to seven days. In some very acute and extra virulent cases of osteomyelitis in infants and children, death may be caused by toxemia in two or three days. In these cases the child seemingly does not experience very much pain, but is dull, stupid, semi-comatose, and often suffers from convulsions.

Diagnosis.—This usually is readily made by considering the age of the patient, the sudden onset, the excruciating pain, high fever, local tenderness, absence of swelling and freedom from joint disturbance.

Prognosis.—This is always grave.

Unless energetic treatment is instituted the patient will ordinarily be confined to the bed for months, and is likely to be crippled for years, while the danger to life is considerable. Not infrequently where the major portion of the shaft of one of the long bones, as for instance the tibia, is impli-

442.—Involucrum—the sequestrum is to be seen through the cloacæ.

Fig. 443.—Acute septic osteomy following amputation.

cated, sufficient irritation is imparted to the epiphyseal cartilages to produce unnatural growth and elongation of the bone, so that the affected bone comes to be an inch, or perhaps more, longer than the corresponding one. In some cases the epiphyseal cartilage is destroyed and growth arrested.

TREATMENT.—The methods of treatment are operative, and may be divided into primary, intermediate or late.

Primary operation: Acute osteomyelitis is an infectious disease having its origin in the interior of a bone, and resulting in the formation of pus. Consequently the indication for treatment is to drain the pus at the earliest possible moment in order to cut short the process, prevent the destruction of bone, and relieve the pain and fever. This treatment is carried out by making a free incision down to the bone over the most tender area, and chiseling a groove in the bone so as to expose freely the infected area, which is then thoroughly removed with a curette. The wound is then drained. Vigorous curettement of the interior of the bone is ordinarily contraindicated, as this measure destroys the endosteum and leads to further necrosis. The window that is chiseled in the bone should be from one-half to one inch wide and long enough to expose freely the limits of the infection. In some cases the window must be cut the entire length of the shaft. If the operation is undertaken sufficiently early, the disease may be aborted and a speedy cure effected. In any event the further progress of the disease will be arrested.

Intermediate operation: First: from the second to the third or fourth week, a free incision may be made, to give free vent to the pus which has perforated the bone and reached the periosteum or skin. Following the incision and the discharge of pus the wound is drained.

Second, an intermediate operation may be undertaken in cases in which there has been necrosis of a part of, or the entire shaft of the bone, for the purpose of cutting short what would otherwise be a long and suppurative process. This is particularly applicable to cases of acute necrosis affecting one of the bones of the leg or forearm, that is, where there is a healthy bone remaining to act as a splint to the parts. The operation may be carried out at any time between the second and eighth week following the inception of the inflammation, and consists in making a free incision down to, and freely exposing, the necrosed area. The dead bone is then separated at each end from the living, by bone forceps or chisel, and carefully shelled out of the thickened periosteal covering. This operation has been especially recommended by Nichols, of Boston.

Late operation: This is done for the purpose of removing a sequestrum (sequestrectomy). This operation is not permissible until the sequestrum has separated, which requires from three to twelve months, depending upon the bone implicated. When the fever, pain and local tenderness have disappeared, separation will be complete and the operation may be proceeded with. This is carried out by making a suitable incision down to and through the periosteum, and then chiseling a window in the bone sufficiently long to enable the surgeon to extract the sequestrum either in its entirety or piecemeal. Following this the cavity is gently curetted, washed out and drained until it closes by the formation of granulation tissue.

ACUTE EPIPHYSITIS.

This is described by some writers as a separate affection. It is an acute osteomyelitis commencing at the epiphysis, usually on the diaphyseal side. It may follow an injury or strain and is due to an infection by one or more of the pyogenic organisms, most frequently the staphylococcus or streptococcus. As a rule the process occurs in young children or in infants, and may lead to epiphyseal separation.

The symptoms and treatment are the same as for a case of acute osteomyelitis.

BONE CAVITIES FOLLOWING OSTEOMYELITIS.

In the head or shaft of the tibia, or in the lower end of the femur, there will sometimes be left, after the removal of the sequestrum, a large bone cavity which will not heal under the ordinary methods of treatment. In these cases Neuber slides in the skin from the adjacent surfaces and tacks it to the bottom of the cavity. Senn fills the cavity with decalcified bone chips. Schede fills the cavity with a blood clot. Each of these methods will occasionally prove successful. More recently the method of Moorhof has been quite generally practised.

For the success of this method it is necessary that the cavity be sterile and dry. The limb may be rendered bloodless with an Esmarch's bandage, and after the removal of the sequestrum and all diseased bone and infected granulation tissue, the cavity is washed, dried, and swabbed with a 95 per cent. solution of carbolic acid, and after two minutes wiped with alcohol. The cavity is then dried and the hæmorrhage controlled. The latter may be accomplished by a gauze packing, by the use of a solution of adrenalin dioxygen or by exposure to the air. The mixture with which the cavity is filled consists of finely powdered iodoform twenty parts, spermaceti and oil of sesame each forty parts. These ingredients are slowly heated to 100° C. and when allowed to cool they form a solid mass. At the completion of the operation the mass is heated to 50° C. and constantly stirred to insure perfect distribution of the iodoform. The mixture is then poured into the cavity until it is filled. The periosteum and soft tissues are then brought together over the cavity, either with or without a small wick for drainage. The results of this method of treatment have been surprisingly good.

ACUTE SEPTIC OSTEOMYELITIS INVADING THE SHAFT AND FOLLOWING AN EXTERNAL WOUND.

This process may arise after an amputation, compound fracture, or following an osteotomy. In any event the wound is septic and the infection is received from without. Before the advent of aseptic and antiseptic surgery the process was much more frequent than it is at the present time (Fig. 443).

Symptoms and Course.—Several days following a compound fracture, amputation or other operation, on a long bone, the patient will have one or more chills, followed by high fever and severe pain in the end of the bone. If there has been an amputation, the stump becomes greatly swollen, very sensitive, and the site of a profuse, watery, purulent and often very offensive discharge. The flaps gape, the end of the bone protrudes and is seen

to be yellow and bare, while from the medullary canal there is projected a mass of foul, fungous granulations. The medullary canal is also the site of a profuse discharge. If the patient survives, the process after two or three weeks gradually subsides with the separation of a sequestrum. This at the lower end comprises the entire thickness and circumference of the bone, but as it progresses upwards more and more of the circumferential lamellæ are preserved by the intact periosteum, so that the sequestrum is tubular and conical, while the cavity in the end of the bone is truncated.

TREATMENT.—This should be carried out early and consists in exposing the infected medullary canal, thoroughly curetting it so as to remove the infected granulation tissue, and then swabbing the cavity with carbolic acid followed by alcohol. By these means, if early undertaken, the infection can be gotten rid of and the process aborted. The wound should also be thoroughly asepticized and drained. If necrosis occurs the sequestrum is removed as soon as it is separated.

An acute septic osteomyelitis may also invade the short bones, or the cancellated structure in the ends of the long bones, following open wounds or compound fractures where the wounds are in a septic condition. The process is attended with chills, severe pain, pronounced swelling and tenderness. The treatment should consist in thoroughly removing the infected material, asepticizing the wound, and establishing free drainage.

TYPHOID OSTEOPERIOSTITIS AND BONE ABSCESS.

Affections of the periosteum or bone occasionally occur following typhoid fever, and are due to the bacillus typhosus. According to Keen the tibia is most frequently involved, and next in order the ribs; although any of the bones of the skeleton may be affected. Caries, necrosis, or bone abscess occasionally may occur as the result of typhoid infection. The process usually comes on several weeks, or it may be months, after the fever.

SYMPTOMS.—There are pain, swelling, and localized tenderness, with little or no constitutional disturbance. Occasionally there are acute exacerbations with slight fever. A bone abscess, the result of typhoid, usually has the characteristics of a cold abscess. Another characteristic of typhoid bone affections is that the pain, swelling and tenderness, after being present for a short time, may entirely disappear, to return again after a longer or shorter period. Ordinarily if resolution does not take place in a few weeks, pus formation occurs.

TREATMENT.—Abscesses when they occur should be freely incised and the adjacent tissue, which, according to Keen, is usually infected, removed with a curette or gouge.

CHRONIC OSTEOPERIOSTITIS.

By this is meant a chronic inflammation of the periosteum and bone. The process may be due to an injury, rheumatism, syphilis, tuberculosis, or to infection from an adjacent ulcer. It may be circumscribed or diffuse; the bone corresponding to the area of inflammation becomes thickened and dense (osteosclerosis). The increase in thickness is due to the formation of new bone by the periosteum and to some extent by the endosteum. In some cases the medullary canal becomes partially or completely occluded

in consequence of the formation of circumferential layers of bone by the endosteum. In localized osteoperiostitis only a portion of the bone is implicated, while in the diffuse process the entire bone may be affected.

SYMPTOMS.—There is a severe, deep-seated, boring pain in the bone, which is worse at night. The bone is enlarged, quite tender and nodular. There are no constitutional symptoms.

DIAGNOSIS.—This will rest upon the chronicity of the process, the apparent cause, the enlargement of the bone and the symptoms. It may be difficult to differentiate a chronic inflammation from a malignant tumor of the bone. The latter process, however, is more circumscribed, the enlargement is likely to be greater, while the surface of the bone is not especially tender or necessarily nodular; and a skiagraph in medullary sarcoma is likely to show a honeycomb appearance or destruction in part of the shaft of the bone. The pain in osteosarcoma is also not increased at night.

TREATMENT.—Rest, elevation of the limb, counter-irritation or the Bier treatment should be resorted to, while internally iodide of potassium or colchicum may be administered. If relief is not obtained an operation should be undertaken. The thickened area of bone should be exposed by free incision, the periosteum stripped back on each side and a long window or gutter chiseled out of the shaft. This may expose a tubercular or typhoid abscess, or a gumma; but if not, it often so changes the nutrition of the bone as to arrest the chronic process. After operation the soft parts are brought together and rest maintained for three or four weeks.

TUBERCULAR DISEASE OF BONE.

The bacilli may be deposited primarily in the periosteum or in the cancellated structure of the bone.

TUBERCULAR PERIOSTITIS.

In this affection the bacilli are implanted within the internal layer of the periosteum, about or within the blood vessels, where they lead to the formation of tubercles and granulation tissue. Later caseation and even suppuration are likely to occur, the pus reaching the surface often by a circuitous route. If the underlying bone has but a thin layer of compact tissue, this is likely to become eroded by the granulation tissue, with infection of the cancellated structures beneath. The process may remain localized or spread along the periosteum to a neighboring joint. Tubercular processes of the periosteum are most frequently seen over the ribs or sternum.

SYMPTOMS AND COURSE.—There is a localized, slightly sensitive swelling, which very slowly increases in size. Local redness and heat are slight or absent. The swelling is primarily doughy but later becomes fluctuant. If the process is allowed to continue the pus after several months will make its way through the overlying tissues, and be discharged.

TREATMENT.—This should be general and local. In the general treatment the patient's health should be improved by fresh air and proper diet. The local treatment consists of a free incision into the abscess, thorough removal by the curette of all granulation tissue, and an excision of that portion of a rib or ribs, or sternum, affected. The wound is then packed with iodoform gauze and drained.

TUBERCULAR OSTITIS.

This has its origin in the cancellated structure of the ends or shafts of the long bones or in the short bones. The process is most frequently seen in weakly, debilitated children of tubercular diathesis. A form which occurs in young children in the phalanges of the hands, less frequently in the feet, is known as tubercular dactylitis, or spina ventosa. In this variety one or several of the phalanges will become implicated either simultaneously or successively.

SYMPTOMS AND COURSE.—In this disease the affected bone becomes slowly enlarged and assumes a spindle shape which is quite characteristic, there is little pain or local tenderness, and no constitutional disturbance, the fingers are separated, the hand fan-shaped and its normal suppleness much interfered with.

PATHOLOGY.—The bacilli reach the interior of the bone through the circulation. Tubercles are formed in and around the blood vessels, and the marrow is converted into granulation tissue. The cancellous structure is gradually rarefied and destroyed, occasionally with the formation of small sequestra, while beneath the periosteum new bone is formed. In untreated or aggravated cases the products of the inflammatory process may perforate the bone and infect the overlying tendon sheaths, soft tissues or adjacent joints; or pus may form, especially in cases of mixed infection, and reach the skin. In these cases pain, local tenderness, redness of the skin and fluctuation will occur.

TREATMENT.—The general health should receive careful attention. The hand should be put at rest and supported on a palmar splint. Passive hyperemia is induced for half an hour night and morning by the application of an elastic constrictor to the forearm according to Bier's method. If the condition progresses in spite of this treatment, short incisions are made over the back of the affected phalanx (avoiding the extensor tendons), the periosteum freely divided, retracted, and a groove in the bone chisled sufficiently large to admit a small curette, by means of which all of the affected medullary and cancellated tissue is removed. The wounds are packed with small strips of iodoform gauze and allowed to heal by the formation of granulation tissue.

TUBERCULAR EPIPHYSITIS.

Tubercular processes in the ends of the large bones of the extremities are of frequent occurrence. The infection usually occurs in the epiphysis, and frequently just beneath the articular cartilage. The implantation of the bacilli leads to the formation of tubercles and granulation tissue. The adjacent trabeculæ are softened, broken down and a cavity formed. The condition is progressive, the bacilli multiply, the granulation tissue increases, the cavity enlarges and finally the process reaches and perforates the articular cartilage, and the contents of the cavity is discharged into the joint, producing infection. In some cases the infection approaches the surface of the bone and the contents of the cavity is discharged beneath the periosteum. In other cases the node or area of tubercular infection excites sufficient reaction within the surrounding tissues to lead to a condensation of the bone about the inflamed area (osteosclerosis), and the

hemming in and sequestration of the node. By this process the infection is prevented from spreading, and not infrequently a cure effected.

SYMPTOMS.—Tubercular epiphysitis is attended with a dull, heavy, aching pain in the head of the bone implicated. The affected portion becomes swollen, the periosteum thickened and hyperemic, and there will be found on careful examination a spot about the size of the finger tip which is very painful on pressure. The adjacent joint often becomes slightly implicated by sympathy and may be somewhat swollen, stiff and painful.

TREATMENT.—This should be instituted as early as possible, in order to prevent an infection of the adjacent joint, and should consist primarily of immobilization under pressure, with passive hyperemia induced by the Bier method. If this treatment does not succeed the limb should be rendered bloodless and an incision made through the sensitive area and down to the bone. The shell of compact bone is then chiseled away and the node sought for with the curette and thoroughly removed. The cavity may then be swabbed with a 95 per cent. carbolic acid solution, followed by alcohol. Two or three strands of catgut may then be placed in the wound and the periosteum and soft tissues closed. The cavity becomes filled with a blood clot which later becomes organized and primary union is obtained. The joint should be immobilized for two or three weeks.

TUBERCULOSIS OF THE SMALL BONES.

Tubercular infection of the short, spongy bones of the tarsus and carpus is of frequent occurrence. The pathological process is the same as that which occurs in the epiphyses. The bacilli become implanted in or around the blood vessels in the interior of the bone, and cause the formation of tubercles, granulation tissue and indirectly the softening and disintegration of the adjacent cancellated structure, with the formation of a cavity. The condition is progressive. The tubercular masses often caseate, break down and form pus, which increases in amount, and may finally reach the surface.

SYMPTOMS.—The symptoms of tubercular ostitis of the spongy bones are, pain, swelling, stiffness and localized tenderness. There is also some constitutional disturbance. The patient has an afternoon rise of temperature, and loss of flesh and strength. The process may be confined to an individual bone, such as the os calcis, the astragalus, scaphoid or cuboid, or implicate all of the bones of the tarsus. In the former case there will be a circumscribed area which is swollen, tender and painful.

The diagnosis is usually readily made by considering the health of the individual, the chronicity of the process and the symptoms.

TREATMENT.—The treatment should consist primarily in immobilizing the parts implicated. If the tarsus is affected, the foot should be immobilized at a right angle to the leg, usually by a plaster-of-Paris cast. Following this the Bier method of passive hyperemia should be pursued. If improvement is not apparent after a few weeks of this treatment the bone should be resected.

(See Resection of Joints.)

PHOSPHORUS NECROSIS.

This usually affects one of the maxillary bones, and most frequently the lower. When the superior maxillary is involved, the process may spread by continuity of structure to almost any of the bones of the face. The disease affects workers in match factories, and especially those who are exposed to the fumes of phosphorus in dipping and handling matches. Hirt claims that persons with carious teeth are affected three times as often as others. It is also claimed that the necrosis is due to a general systemic poisoning. Necrosis of the jaw has also been known to follow the internal administration of phosphorus. The process affects by preference, weak, anemic and debilitated individuals. In the majority of the cases the fumes are supposed to enter the cavity of a carious tooth, cause inflammation in the peridental membrane, which readily spreads to the periosteum. With the inception of the inflammation the teeth ache, become loose and are finally picked out. As the disease spreads the periosteum covering the jaw becomes loose and separated from the bone, which undergoes necrosis. The gums are greatly swollen and the site of a most profuse, seropurulent and offensive discharge. This discharge is often so considerable that it almost runs constantly from the patient's mouth, and is at the same time so offensive that the patient can scarcely be tolerated in the house. At various points beneath the swollen gums the dead bone can be felt with a probe, or be seen. In consequence of the pain, inability to take any considerable nourishment, the profuse discharge, and the poisoning of the system, the patient becomes greatly reduced in flesh and strength. Coincident with the necrosis the periosteum forms a layer of new bone surrounding that which is undergoing necrosis.

TREATMENT.—Proper ventilation should be established and exhaust-fans placed over the pans in factories, in order to remove the fumes. The hands of the workmen should be thoroughly washed and the teeth carefully brushed before meals. Persons in poor health, or with carious teeth should not be employed in match factories. In some factories operatives wear about the neck open bottles containing turpentine, under the belief that the fumes of turpentine neutralize those of phosphorus. With the onset of periostitis the patient should be removed from the factory and instructed to gargle the mouth and scrub the teeth and gums frequently, with some mild antiseptic solution, such as dioxygen, chloride or permanganate of potash, or borolyptol. If suppurative periostitis becomes established, a free incision should be made through the gums and periosteum for the purpose of giving vent to the pus. The sinuses and pus cavities should be frequently syringed out. The sequestrum, if one forms, should not be removed until it is quite loose—this for the purpose of preserving the periosteum and new bone intact until sufficient bone has formed to maintain the normal contour of the jaw, at which time, as a rule, the dead bone will have been separated, when it may be readily picked out of its bed of granulations after dividing the overlying soft tissues.

MERCURIAL NECROSIS OF THE JAW.

This condition may occur to a limited extent as the result of the inhalation of the fumes of mercury, or from its internal administration. The

process commences as a severe salivation, with swelling of the gums, loosening of the teeth, and a profuse, offensive discharge. Periostitis may follow and result in superficial necrosis.

TREATMENT.—The internal use of mercury should be stopped, and if the patient is exposed to the fumes of mercury, he should change his occupation. Mild antiseptic gargles should be used, especially chlorate of potash, while iodide of potash may be given internally. If suppurative periostitis occurs free incision should be made to give vent to the pus. If a superficial sequestrum occurs, it may be readily removed after it has become detached.

TUMORS OF BONE.

These are the osteomata, odontomata, fibromata, sarcomata, endotheliomata and carcinomata. The osteomata, chondromata, and fibromata are rare neoplasms in these situations, and have already been considered in the chapter on Tumors. The sarcomata and endotheliomata cannot be differentiated clinically. The sarcomata may be divided into two classes, the endosteal or medullary, and the periosteal growths. The endosteal tumors may still further be divided into myeloid or giant-cell sarcomata and the

Fig. 444.—Round cell sarcoma of the radius with the formation of new bone.

spindle or round-cell sarcomata. The giant-cell sarcoma commences in the medulla, is of very slow growth and almost benign in character. It rarely, or not until late, infects the adjacent tissues or interferes with the general health of the individual. Locally there is a gradual expansion of the bone at the site of the growth, with slight pain and tenderness. The seats of predilection for the myeloid sarcomata are the lower jaw, the lower ends of the femur and radius, and the upper ends of the tibia and humerus (Fig. 445a. X-ray picture of sarcoma of lower end of radius).

(2) The endosteal tumors, composed of spindle or round cells, are at times extremely malignant. Their growth is frequently rapid and they expand, often perforate, the overlying bone and lead to infection of the adjacent tissues.

(3) The periosteal sarcomata are usually composed of round or spindle cells. The round cell variety is often quite malignant, while the spindle cell is semi-benign. They usually make their appearance in young adults, and depending largely upon their vascularity, may grow rapidly or slowly.

DIAGNOSIS OF SARCOMATOUS GROWTHS OF BONE.—This may be easy or difficult, depending upon the situation and size of the growth. In endosteal sarcomata there may be difficulty in differentiating the process from

Fig. 445a.—Sarcoma of the lower end of the radius.

Fig. 445b.—Sarcoma of the radius.

a chronic osteomyelitis, and osteoperiostitis, an abscess of the bone, or a gumma.

A gumma is of rare occurrence, grows slowly, is circumscribed, and the case should give a history of syphilis. An abscess is usually associated with some fever, severe pain and will give a history of infection.

Chronic osteomyelitis, usually is of tubercular origin and frequently does not produce any considerable enlargement of the bone.

In an osteoperiostitis the new growth is external to the bone, and this fact is usually capable of recognition. The X-ray may be of service, and in some cases an incision may be necessary in order to establish the diagnosis. A soft, cellular growth within the interior of a bone, is almost certainly malignant.

The periosteal growths are circumscribed, but not encapsulated. They usually have an unequal consistency in consequence of the formation of cysts, and are fixed to the bone.

TREATMENT.—Medullary myeloid sarcomata are usually mildly malignant, and if the soft tissues have not been invaded they may be treated by conservative methods, that is, by chiseling a good sized opening in the bone and then thoroughly curetting the growth away.

In the round and spindle-cell medullary sarcoma, and in the periosteal sarcoma, free excision of the affected bone is required.

An endosteal sarcoma may be secondary to sarcomatous process situated elsewhere in the body.

Carcinomata of the bone are always secondary, and frequently follow cancer of the breast. The process often affects several bones either simultaneously or successively. The affection is attended with a severe boring pain in the bone implicated, the pain being often so severe as to require large doses of morphine. The bone affected is usually somewhat tender, but seldom enlarged.

Sarcomata and carcinomata when affecting the long bones secondarily, are quite likely to lead to spontaneous fracture. These fractures, however, may readily unite under proper treatment.

Secondary malignant affections of bones are not amenable to operative treatment.

SCURVY RICKETS (BARLOW'S DISEASE.) INFANTILE SCURVY. HEMORRHAGIC RICKETS.)

This condition was first described by Sir Thomas Barlow, and presents the symptoms of scurvy in a rachitic child. It occurs in children of the better classes and is apparently due to the too early administration of starchy food, to the exclusion of milk and other animal foods. Sterilized milk may also be a causative factor. The process usually comes on between the fourth and eighteenth month and is attended with fever, pains in and tenderness of the bones or periosteum. The femur and tibia are most frequently affected, and subperiosteal hæmorrhages, and even epiphyseal separations or spontaneous fractures, may occur. Epistaxis, hematuria and hæmorrhage beneath the conjunctiva, or blood-stained stools, occasionally occur.

PROGNOSIS.—The disease usually responds readily to treatment, but in some cases the child grows progressively weaker, the hæmorrhages are increased and the patient dies from exhaustion.

TREATMENT.—The child should be placed under the best hygienic surroundings and given fresh milk, meat juice and lime water, and in older children fresh vegetables and cod liver oil should be added. It may be necessary in severe cases to protect the limbs from injury.

SCURVY.

This is a constitutional disease due to improper food and bad hygienic surroundings. It is characterized by a general disturbance of nutrition and a marked tendency to hæmorrhage in the various tissues of the body. Scurvy was formerly most frequently met with among sailors who were obliged to make long sea voyages, during whcih they were deprived of fresh vegetables, fruits and meats. At the present time sporadic cases of scurvy are occasionally met with. The disease is most frequently encountered, however, in camps and in almshouses, where the food is improper, and where bad hygienic conditions prevail, such as dampness, foul air, and depressing influences. It is held by Garrod and by Ralpe that deficiency in the potassium salts, and more especially the alkaline carbonates derived from vegetables and fruits, is the most patent causative factor. Impure water is also a factor in the production of scurvy. In Russia, where the disease is endemic and at times epidemic, it is thought by some to be due to infection.

SYMPTOMS AND COURSE.—This is marked by decided weakness and lassitude. The patient is depressed, drowsy, apathetic, and indisposed to exertion. The respiration and heart action are readily excited. There are muscular pains throughout the body. The skin is dry, and of a yellowish hue. There is an absence of fever. After these symptoms have continued for several weeks, the disease becomes fully established. At this time the gums swell, become œdematous, and assume a bluish tint. When the disease is well established there is an almost constant oozing of blood from about the teeth, the breath is most offensive, hæmorrhages from the nose are frequent and difficult to control; numerous small or large extravastations of blood appear beneath the skin. Vesicles may form over these areas and grow into ulcerations which are progressive and often the site of hæmorrhage and of a profuse foul discharge. Hæmorrhage may also occur in the muscles and beneath the periosteum into the joints, and from the mucous and serous surfaces. Fever is also present during the height of the disease, as the result of absorption of the septic products from the mouth and from the phagedenic ulcers.

DIAGNOSIS.—This will depend upon the patient's surroundings, the state of general malnutrition, the swollen and hæmorrhagic gums, the hæmorrhages beneath the periosteum, and into the soft tissues, and the muscular and periosteal pains.

PROGNOSIS.—This is usually favorable if the patient comes under treatment sufficiently early.

TREATMENT.—The patient should be placed under the best possible hygienic conditions. Antiseptic mouth washes should be frequently used.

The appetite should be encouraged and the patient given fresh vegetables, meats, fruits and milk. Internally, iron, quinine, strychnine and arsenic are to be advised. When ulcers occur they should be treated antiseptically.

OSTEOMALACIA. MOLLITIES OSSIUM.

This name is applied to a condition of softening of the bones in adults. The process is rare in this country, but among the poorer and lower classes in some portions of middle Europe it is of frequent occurrence. It more especially affects pregnant or nursing women, but may occur in young girls about puberty, or even in men.

CAUSATION.—In some countries the disease is practically endemic. It has been attributed in part in these countries to bad hygienic surroundings, such as cold, damp and poorly lighted dwellings, in which the women customarily sit upon the floor. Associated with these conditions are frequent pregnancies, long continued lactation, and poor and often insufficient food. In these women the bones of the pelvis and the femora are especially affected.

SENILE OSTEOMALACIA.

This form occurs especially in the aged and insane of both sexes. The spine, ribs and skull are more especially implicated. Where the long bones are affected fractures readily occur.

OSTEOMALACIA OF PUBERTY.

This condition has been ascribed to bad hygienic conditions, anemia, and poor food, associated with some disturbance of the functions of the ovaries.

PATHOLOGY.—The bones become hyperemic and then softened as the result of the absorption of the lime salts. The marrow is especially vascular, red and often the site of hæmorrhages. Later it may become fatty. The bones are more porous than normal in consequence of the widening of the Haversian canals, and canaliculi.

SYMPTOMS AND COURSE.—The first indications of the disease are the occurrence of aching pains down the thighs, in the pelvis, along the ribs and in the sternum. The affected bones are very sensitive to pressure. Later the bones become deformed. The femora are curved and their necks displaced downwards (coxa vara). The patients, as a result of these deformities, are somewhat stunted. The pelvis becomes deformed, the acetabula are approximated, and the pubes and promontory of the sacrum are pushed forward. The urine usually contains an excess of lime and phosphates, and albumen is occasionally present.

DIAGNOSIS.—This will be established by considering the sex, environments, the pain in and localized tenderness over the bones, and the deformities.

PROGNOSIS.—If the hygienic conditions can be changed and pregnancy prevented, recovery often occurs. If the conditions are not changed the patient usually succumbs as the result of exhaustion, bronchitis, or affections of the kidneys.

TREATMENT.—This consists in improving the diet and the general hygienic conditions, so that the patients will have fresh air, sunlight, dry dwellings, fresh vegetables, meat, milk and fruit. Pregnancy if possible is to be prevented and lactation stopped. Small doses of phosphorus should be administered. In some cases the ovaries have been removed with beneficial results.

FRAGILITAS OSSIUM.

This is a peculiar state of the long bones, which occasionally makes its appearance in children or adults. The condition may follow rickets, scurvy, osteomalacia, or some one of the general or specific diseases that come on during senility. The process may depend on bad hygienic surroundings or be inherited. Often there is no assignable cause, but the patient breaks bone after bone from slight falls or muscular action. The union is often faulty and attended with deformity which is progressive.

PROGNOSIS.—In fragilitas ossium the condition is ordinarily recovered from at or about puberty.

TREATMENT.—This should consist in placing the patient under the best possible hygienic and dietetic conditions. The diet, in part, should consist of fresh milk, vegetables, meat and fruit. Cod liver oil may be given, and while the disease continues the patient should have the long bones protected by splints.

ACROMEGALY.

This is a disease of the pituitary body leading to enlargement of the bones of the hands and feet. In giants, and men of especially powerful muscles, the pituitary body is said to be enlarged. In typical acromegaly there is a new growth in the pituitary body which produces pressure upon the optic tract and gives rise to those symptoms usually present in cerebral tumors. The new growth may be a cystic adenoma, a glioma or a sarcoma. The body may be the site of hypertrophy, colloid degeneration or hæmorrhage.

SYMPTOMS AND COURSE.—The disease may make its appearance at any time between the fifteenth and sixtieth year of age.

The head is enlarged and the bones of the skull thickened. The chin is prominent and the lower jaw much enlarged. The superciliary arches and bones of the nose and face are thickened and enlarged. The nasal cartilages are thickened, producing enlargement of the nose; the skin of the face is much thickened; the lower lip is thickened and prominent. The fingers become greatly enlarged and sausage-shaped. The feet are somewhat similarly affected. The spine is often curved (kyphosis, lordosis or scoliosis). The chest is usually flattened from side to side, with some enlargement of the ribs, clavicle and scapula. The bony enlargements are largely due to periosteal thickenings which are very often quite marked at the site of muscular and ligamentous attachments. The tongue and ears are often enlarged and the speech thick. At a later period optic atrophy with blindness, followed by symptoms of cerebral tumor, occur.

CRETINISM.

This condition may be congenital or acquired. It is a form of idiocy associated with absence or atrophy of the thyroid. In congenital cases the child is born with the characteristics of cretins. In infantile cases the condition is acquired. The cretin is a dwarf lacking in mental and bodily development. He has a large face and mouth, thick lips and tongue, and a broad nose. The bones of the skeleton are short and broad, and the epiphyses swollen. The cretin of adult age does not exceed in stature a child of five

Fig. 446.—Achondroplasia.

or six years. It is held generally that cretinism, whether endemic or sporadic, is due to some affection of the thyroid gland.

TREATMENT.—Thyroid extract is given in full doses.

ACHONDROPLASIA.

This is a name given to a peculiar congenital condition in which the diaphyses of the long bones fail to grow. The epiphyses are thick, while the diaphyses are extremely short. The process affects the long bones of the upper and lower extremities. The fingers are short and stumpy. The

head looks unusually large. The trunk is normal length, while the skin, hair and genitales are normal. The gait is waddling and the patient is dwarfed simply on account of an arrest of development in the long bones (Fig. 446).

ATROPHY OF BONE.

ECCENTRIC ATROPHY.

This proceeds from the center outwards; the osteoclasts bordering the marrow cavity produce absorption and enlargement of the medullary canal. The process may be carried on until there is but a shell of the compact bone left. As the result of this absorption the bone is very much weakened and spontaneous fracture is frequent. The process occurs from disease and in old age.

Eccentric and concentric atrophy may occur from disuse, as in the stump of an amputated limb which becomes smaller and conical. Concentric atrophy in which the surface of the bone becomes eroded is often due to pressure, as from aneurism, to infection, and to new growths. The substance of the bone may be largely absorbed and still its shape and form be maintained, as in osteoporosis, in which the Haversian canals are very much widened, so that compact bone is converted into cancellated, and cancellated bone practically disappears.

Neuropathic atrophy may occur after injuries to the spinal cord or to nerves. It is largely eccentric.

Senile atrophy: This affects very markedly the flat bones. Those of the skull may be so changed that the outer table and diplo largely disappear. the skull may be so changed that the outer table and diploe largely disappear. The bones of the face become thinner, the lower jaw loses much of its angle, becomes lighter and less prominent. The long bones are also atrophied in old age and especially the neck of the femur, making fractures from slight causes frequent. Localized atrophy of an individual bone may at times be partially corrected by the production of passive hyperemia by Bier's method, by counter irritation or by boring the bone.

HYPERTROPHY OF BONES.

The long bones frequently become hypertrophied in consequence of chronic inflammation. The process may affect a part of the shaft, or the entire bone. The Haversian canals become narrowed as a result of the formation of additional lamellæ, and the bones more dense than normal (osteosclerosis). In addition to the sclerosis, circumferential lamellæ may be formed beneath the periosteum and internally, around the medullary canal, making the bone much thicker than normal (hyperostosis).

Exostoses and osteophytes are local formations of new bone which frequently occur near the epiphyseal junctions. The osteophytes are small pointed outgrowths; the exostoses are larger and may form tumors of considerable size, or osteomata.

Endostoses are new growths situated within the old bone.

Exostoses and osteophytes, if causing annoyance should be removed by exploring the growth through a proper incision and then chiseling it away at its base.

GONORRHEAL EXOSTOSIS.
(PAINFUL HEEL.)

This condition develops in the course of a chronic gonorrhœal process and is due, as has been shown by Baer, to the local action of the diplococcus of gonorrhœa.

The exostosis is situated usually on the os calcis and is responsible for a most painful and disabling affection.

TREATMENT.—This is very satisfactory in its results and consists merely in cutting down upon the exostosis and removing it.

CHAPTER XXIII.

SURGICAL AFFECTIONS OF THE SPINE.

SPRAINS.

These are due to falls or blows received upon the back, to hyperextension, hyperflexion or to extreme lateral motion. The muscles or fascia may be torn, or the ligaments connecting some parts of the vertebræ ruptured. Hæmorrhage may occur beneath the skin, within the muscles, or even into the spinal canal. Any portion of the spine may be injured, but most frequently injuries occur in the cervical or dorsal region.

SYMPTOMS.—Localized pain, aggravated by motion, ecchymoses, tenderness upon pressure and occasionally slight fever occur. Where the injury is in the lumbar region there may be inability to move the legs or relieve the bladder or bowels, in consequence of pain caused by the muscular exertions. Involvement of the nerves may give rise to persistent neuralgia.

TREATMENT.—Rest in bed, with hot fomentations or evaporating lotions, should be resorted to until the acute symptoms have subsided. Then the patient should be allowed to be up, while each day or second day the muscles of the back are massaged.

DISLOCATIONS.

Dislocations of the spine are very infrequent, and excepting the coccyx, occur in the cervical region only. The displacement is usually caused by hyperflexion in consequence of which the articulating surfaces of the vertebræ above are lifted upwards and forwards over those of the vertebræ below. Dislocations may also occur as the result of extension from the head, as in lifting a person by the head or neck, in which case the odontoid process of the axis is usually displaced.

Unilateral displacements may occur from extreme rotation of the spine. In the cervical region, any of the vertebræ may be displaced. The occiput has been dislocated from the atlas, usually resulting in sudden death, or the atlas may be displaced from the axis. If the odontoid process has been fractured, or the transverse ligaments torn, death is usually instantaneous from compression of the cord, the body of the atlas slipping forward. The dislocations may be bilateral or unilateral, and with very rare exceptions are forwards.

PATHOLOGY.—The intervertebral disks are either torn or separated. The capsular ligaments are always ruptured and the anterior and posterior ligaments either torn entirely or partially. The ligaments between the laminæ and spinous processes are either torn or greatly stretched. Fracture of some portions of the vertebræ or its processes not unfrequently complicates the dislocation.

SYMPTOMS.—*Unilateral Dislocations.* The head is turned towards the opposite side and fixed. The line of the spinous processes is altered and irregular; there is usually tingling, numbness, or neuralgic pains in the parts supplied by the nerves taking origin from the injured area. Paralysis does not often occur. If the displacement remains unreduced, the head becomes fixed in its abnormal position, with more or less of pain in consequence of the pressure of the bone upon adjacent nerves.

TREATMENT.—The patient should be anesthetized, and an effort made to reduce the dislocation by carrying the head slightly further in the direction to which it inclines. This is done for the purpose of unlocking the articulating surfaces. Extension is then made while the head is brought round to its normal position.

BILATERAL DISLOCATIONS.

A bilateral dislocation, if complete, is always accompanied by pressure upon the cord and paralysis. If the dislocation is only partial the cord may escape special injury or pressure.

TREATMENT.—Reduction should be attempted by extending the head and neck and then making traction in a direction upwards and backwards. If these measures fail the region should be exposed by incision and an effort made, before or after partially removing the articulating processes of the lower vertebræ, to reduce the dislocation, and failing in this the spinous processes and laminæ of the displaced vertebræ should be cut away.

FRACTURES OF THE SPINE.

Fractures of the spine constitute about three per cent. of all fractures. These fractures most frequently occur through the cervical or dorsal regions, and the vertebræ most frequently implicated are the fifth and sixth cervical, the twelfth dorsal and the first lumbar. Fractures of the spine may be caused by direct or indirect violence. They are caused by direct violence as when one receives a severe blow upon the back, or falls from a height, striking the back against some hard, projecting object. Fractures by direct violence are also produced in gunshot injuries of the spine. Fractures by indirect violence are usually caused by the patient falling from a height and alighting upon the feet, buttocks or head.

INCOMPLETE FRACTURES.

The spinous processes are broken by direct force. These fractures are as a rule confined to the lower cervical and dorsal regions, in consequence of the spinous processes in the upper cervical and lumbar regions being either very short, as in the lumbar region, or well protected by the erector spinæ muscles as in the upper cervical region.

SYMPTOMS.—The symptoms of fracture of the spinous processes are usually those of a local trauma. There will be localized pain and swelling, the former being increased by motion, tenderness on pressure, with an irregularity in the line of the spinous processes, and preternatural mobility of the fractured processes. This mobility may be attended with crepitus. Sensation and motion in the extremities are not interfered with.

FRACTURES OF THE LAMINAE.

These fractures are not infrequent, and result from direct violence. If but one lamina is broken the displacement will not be marked and the cord as a rule will not be injured. If both laminæ are broken the spinous processes with the attached portion of the laminæ are likely to be driven in upon the cord producing paralysis.

PARTIAL FISSURED FRACTURE OF THE VERTEBRAE.

These occur through the bodies of the vertebræ and unattended with displacement are not followed by paralysis or interference with sensation. In incomplete fractures, without displacement of the fragments, paralysis may occur either immediately from concussion of the spine, or more or less from hæmorrhage or the pressure of inflammatory exudates.

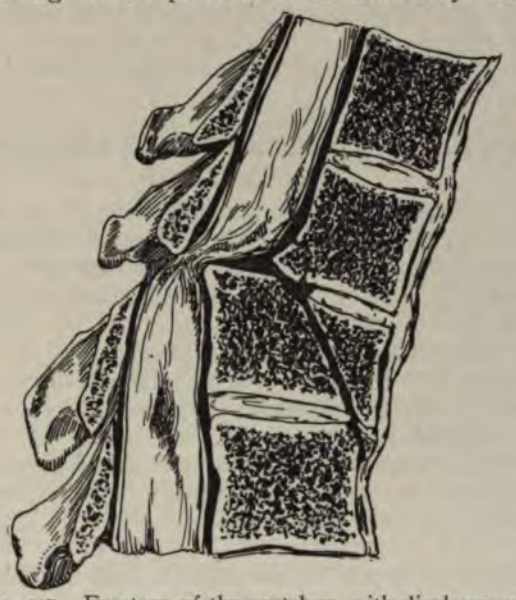


Fig. 447.—Fracture of the vertebræ, with displacement.

TREATMENT.—In those cases in which the spinous process with its laminæ are driven down upon the cord, producing paralysis—the proper treatment is to expose the displaced bone by incision and remove it. Aside from this, the treatment of incomplete fractures consists of rest in bed for three or four weeks.

COMPLETE FRACTURES.

FRACTURES OF THE BODIES OF THE VERTEBRAE.

These fractures are usually associated with more or less displacement, with pressure upon and injury to the cord. In fractures of the vertebræ the spinous processes, laminæ and articulating processes may or may not be broken, but the ligaments, the interspinous, supraspinous and subflavous are usually torn. The upper or movable portion of the spine is driven forwards and downwards over the lower and fixed portion, the spinal cord

is compressed and often irreparably injured between the upper end of the lower vertebra and the laminæ of the vertebra above. In cases in which the displacement is less marked the cord and membranes may escape with slight injury (Fig. 447).

SYMPTOMS.—The symptoms are pain, increased by motion, tenderness or pressure, ecchymosis, angular deformity and paralysis.

SYMPTOMS IN FRACTURES OF SPECIAL REGIONS.—Fractures of the lower three lumbar vertebræ are uncommon, and, as a rule, unattended with special symptoms. In consequence of the cord terminating at the level of the second lumbar vertebra, paralysis in these fractures does not occur.

The symptoms of fracture in this region are ordinarily local pain, tenderness on pressure, ecchymosis and great weakness when the patient attempts to stand. Deformity, crepitus, and preternatural mobility, are usually absent, and, excepting the first, should not be sought for.

PROGNOSIS.—The prognosis of fractures of the lower lumbar region is usually good.

FRACTURES BETWEEN THE SECOND DORSAL AND SECOND LUMBAR VERTEBRAE.

In fractures through this region there is likely to be paralysis of the lower limbs, bladder and rectum, with loss of sensation below the seat of injury. In fractures through the upper dorsal region the intercostal and abdominal muscles will also be paralyzed, and there will be distension of the intestines with gas.

In fractures through the region comprised by the second dorsal above and second lumbar below, the urine will be retained, often becomes ammoniacal and infected, cystitis following. Bed sores, hypostatic congestion of the lungs and pneumonia are frequent.

PROGNOSIS.—The prognosis of fractures in this region is distinctly unfavorable, although if the cord is not seriously damaged and pressure can be relieved, complete recovery may occur.

FRACTURES BELOW THE AXIS AND ABOVE THE THIRD DORSAL VERTEBRA.

In fractures through the first or second dorsal vertebra but one cord of the brachial plexus will be involved. In fractures of the cervical vertebræ both the upper and lower extremities will be paralyzed.

PROGNOSIS.—The prognosis in fractures of the cervical region is very grave. In fact, the higher the fracture is situated in the spine the more serious is the prognosis.

FRACTURES OF THE AXIS AND ATLAS.

Fractures through the upper part of the cervical region, including the axis and atlas, are usually either immediately fatal, or lead to death within a few days or weeks.

TREATMENT OF FRACTURES OF THE SPINE.—The patient should be placed in bed, on a hard mattress, and kept scrupulously clean. A sponge bath and an alcohol rub should be given each day, followed by a dusting

powder over the back and sides. For the purposes of the bath the patient may be gently turned upon his side. In fact, the patient's position should be frequently changed in consequence of the great liability to pressure bedsores. In consequence of the nerve influence being withdrawn from the lower limbs their vitality is greatly reduced and any prolonged pressure or infection is likely to be the starting point of serious sloughing in the skin and subcutaneous tissues. It is often necessary to relieve the nates, calves of the legs and heels from pressure by placing inflated rubber rings about them, or rings made of absorbent cotton; and for the purpose of relieving prominent points from pressure the patient may be placed upon an air or water bed. The urine should be drawn regularly under the strictest antiseptic precautions, the catheter being perfectly sterilized, the head of the penis washed and the urethra irrigated before the introduction of the catheter. After the patient is placed comfortably in bed and the shock is relieved, the most important consideration is the correction of the deformity, if one exists, and the relief of the cord from pressure. The recumbent position with slight extension may correct the deformity and relieve the pressure. In these cases nothing further is required, except in the general care of the patient, unless it is thought best to immobilize the spine by the application of a plaster of Paris cast.

In cases in which the deformity is not corrected by recumbency and slight extension, laminectomy should be done. The patient is anesthetized, turned upon his side and the fractured region thoroughly asepticized. The spinous process immediately above the fractured vertebra is displaced forward and partially hidden. The spinous process of the fractured vertebra is prominent. The center of the incision should be placed over the displaced spinous process, and should ordinarily be three or four inches long. The incision is deepened and the tissues separated by blunt dissection and held aside by large blunt retractors until the laminæ which are producing the pressure on the cord, and which belong to the displaced vertebra, are reached. The spinous process with these laminæ should then be cut away with bone forceps. If the laminæ of another vertebra seem to be producing pressure upon the cord they may also be removed. If the dura is distended, possibly by a clot of blood, it should be incised and the blood clots removed. It may then be closed with a few catgut stitches. The depth of the wound should be drained, the muscles united with catgut and the skin brought together by silkworm gut. The spine may then be immobilized with a plaster of Paris cast.

FRACTURES OR DISLOCATIONS OF THE COCCYX.

These may occur as the result of direct falls or blows. The coccyx may also be displaced backwards during the act of parturition. The deviations of the coccyx may be forward, backwards or lateral. The displacements are associated with a severe and constant pain in the coccyx, which is aggravated by muscular exertion, such as standing and walking, and especially aggravated during defacation. This constant wearing pain, with forced confinement, produces a chronic state of invalidism, with loss of appetite, anemia and general debility. Contusions without displacement, especially in women, often lead to a severe

PROGNOSIS.—This will depend upon the amount of injury done the cord by the clot.

TREATMENT.—This is practically the same as that for concussion and contusion of the spine. The patient is confined to the bed with an ice bag applied to the spine. The bowels are kept open and ergot is administered internally. When the acute symptoms have subsided iodide of potash may be given internally and counter irritation applied externally.

EXTRAMEDULLARY HEMORRHAGE (HEMATORRHACHIS).

Hemorrhage between the vertebra and dura, or into the membranes, is much more frequent as the result of an injury, than is hæmorrhage within the cord.

SYMPTOMS.—Pain is usually severe and associated with a hyperesthetic zone of the skin, which corresponds to the distribution of the spinal nerves taking origin from the seat of the injury. Muscular spasms are frequent and more or less extensive. Paraplegia occurs. The paralysis does not come on as suddenly, nor is it usually so complete as in intramedullary hemorrhage.

PROGNOSIS.—The prognosis is comparatively favorable in extramedullary hemorrhage.

TREATMENT.—This should consist in rest, the application of an ice bag to the spine, the administration of ergot, and a thorough opening of the bowels. If the functional disturbance of the cord produced by the pressure of the clot is not soon relieved, a laminectomy should be done and the clot removed.

SPINAL MENINGITIS.

ACUTE SPINAL MENINGITIS.

This may be the result of an injury plus infection. The inflammation is usually diffuse, but confined to the arachnoid and pia mater. (Leptomeningitis.)

Pathologically there is an inflammatory exudate and a collection of a yellowish fluid often containing pus. The membranes become dull and are often the site of adhesions. The inflammation is prone to extend to the membranes of the brain.

SYMPTOMS.—The process is often ushered in with a chill followed by high fever and severe pain in the back, which radiates around the body and down the limbs, with hyperesthesia of the lower limbs, increase of the reflexes, and muscular spasms. As the case progresses signs of myelitis are likely to develop, with paraplegia and paralysis of bladder and rectum. The spine is rigid and the pain in the back increased by motion. If the process extends to the membranes of the brain there will be intense headache, vomiting, photophobia, delirium, stiffness of the neck with retraction of the head, and often convulsions.

The prognosis is unfavorable.

TREATMENT.—The treatment should be primarily preventive. Any wound involving the spine should be thoroughly asepticized and perfectly drained. If an acute infective inflammation of the spinal membranes has occurred it is not probable that any operative measures will control it, al-

though if the process is circumscribed a laminectomy may be done, the dura freely incised and the infected area drained. Ordinarily the treatment will be confined to the application of an ice bag to the spine, the relief of pain, the administration of ergot and the thorough opening of the bowels.

CHRONIC MENINGITIS.

In exceptional cases this may result from an acute attack. The process is usually circumscribed and may be confined to the arachnoid and pia mater, or the dura mater may be implicated. (Pachy-meningitis.)

There is hyperemia and inflammatory exudate with adhesions and thickening of the membranes. The process may extend to the cord and produce myelitis.

SYMPTOMS.—There is pain in the back, increased by motion. This pain often extends around the body, or into the limbs. The reflexes are exaggerated. There is cutaneous hyperesthesia and muscular cramps.

TREATMENT.—The patient should be confined to the bed, and iodide of potash or mercury may be administered. Blisters may be applied to the spine or the actual cautery employed.

SPINAL MYELITIS.

Inflammation of the cord may result from spinal injuries either with or without fracture of the bones. It may also be secondary to inflammatory processes in the membranes.

ACUTE MYELITIS.

SYMPTOMS.—The onset is usually sudden, it may be preceded by pains in the limbs or a girdle-like sensation about the body. With the onset there are chills and fever and a rapidly occurring paraplegia. Primarily there is hyperesthesia and following this anesthesia. The reflexes are first increased and then lost. The rectum and bladder are paralyzed, the muscles waste, bed sores and cystitis occur. The inflammation may result in death in from five to ten days, or in less acute cases may be more prolonged and even become chronic.

TREATMENT.—An ice bag should be applied to the back, and ergot, iodide of potash or mercury administered. Counter-irritation is also to be recommended. The bowels are to be thoroughly opened. If the cord is being compressed by the laminæ, either in consequence of fracture or dislocation of the spine, the corresponding spinous process with its laminæ should be exposed and both resected.

CHRONIC MYELITIS.

This may be but the sequence of an acute attack, or it may come on as an original affection and be the result of an injury.

The symptoms are complex. In cases which are chronic from the first there is a slowly progressive weakness of the muscles of the legs. The anterior tibial, flexor and peroneal muscles are more seriously affected than are the muscles upon the posterior surface of the legs. With this weakness there is a feeling of numbness, or as of pins and needles in the extremities. The deep reflexes are usually exaggerated and the muscles atrophy. There

is functional derangement of the bladder in that the patient is unable to empty it completely. Loss of sexual power in men is common. The patient's general health, however, is good. The muscular weakness continues until finally the patient is confined to his bed and unable to move his limbs.

PROGNOSIS.—The course of the disease is usually progressive, although temporary improvement may occur.

TREATMENT.—If depressed bone is the cause of the disease it should be removed. Internally, mercury or iodide of potash may be given; externally, blisters or the actual cautery should be used.

TRAUMATIC NEURASTHENIA. RAILWAY SPINE. RAILWAY BRAIN. INDIRECT CONCUSSION OF THE SPINE.

By this condition is understood a functional disturbance of the spinal and cerebral centers in persons who have been subjected to railway or other severe injuries. It seems necessary in order that traumatic neurasthenia be produced, that the patient's nervous system be suddenly, unexpectedly and profoundly shocked. The condition is characterized by muscular and mental weakness, nervous irritability and pain. It has been explained that the reason why so-called traumatic neurasthenia follows railway injuries, is that great force is expended in the collision, the accident is unexpected, and the shock, mental disturbance and fright incident to the injury are usually very severe and trying to a sensitive person's nervous system. The patient at the time of the injury may have received a severe shaking up, such as results from being thrown from side to side about the car, may have been severely bruised or sustained a fracture of one or more bones, or the dislocation of some joint. Or there may have been practically an absence of physical injury—only a most profound and terrifying nervous impression. In either event the patient immediately or in a few days, experiences a severe pain in the back and head, associated with great muscular weakness, mental depression and nervous irritability. The patient is scarcely able to walk and is obliged to take to his bed. There is, however, an absence of paralysis and the reflexes are usually not disturbed, or are perhaps slightly exaggerated. At times the reflexes in the sole of the faradic brush are abolished. There is an absence of fever, the pulse is weak and the extremities are cold. If the patient gets up he is unable to walk, or to walk more than a short distance. He becomes quickly exhausted, his legs give out, and on exertion the pain in his back and head are increased. He is unable to apply himself to business, cannot fix his attention; he has confusion of ideas, his mind wanders and he becomes mentally fagged. The patient is also greatly depressed and fearful, loses confidence in himself and if able to walk, desires some one to go with him. Usually, however, he avoids society. The patient often sweats profusely, at times has precordial pain, and palpitation of the heart on the slightest excitement or exertion. The patient may be confined to the bed but a few days or for weeks. Ordinarily after a few days he is able to be up and around, with some aid. On examination the spinous processes are found to be tender at one or more points. The muscles are soft and their contractions weak. Sight is often deficient, and the patient is unable to accommodate for near

objects (presbyopia). There is often numbness and tingling in the extremities, frequently associated with hyperesthesia or anesthesia.

DIAGNOSIS.—This will depend upon ascertaining the circumstance of the injury, the patient's mental condition, weakness of his muscles, the presence of pain in the head and spine, nervous irritability, his fears and depressions, without associated paralysis, or marked change in the reflexes.

PROGNOSIS.—Insofar as life is concerned the prognosis may be said to be good, although any condition which markedly lowers the vitality and power of resistance of the individual makes him more susceptible to disease and less able to withstand it when once contracted. The majority of patients suffering from traumatic neurasthenia make a fairly good recovery. At least they are subsequently able to attend to their vocations. A goodly number do not entirely recover and are nervous and wretched for the remainder of their lives.

TREATMENT.—The mental worry, anxiety and distress incident to a suit for damages are quite sufficient to prevent improvement in this class of cases. In the treatment the patient's mind must be freed from anxiety and annoyance, and he should be under cheerful surroundings, led away from the scenes of his troubles and made, if possible, to forget them. The morning cold shower or sponge bath is very serviceable, especially when followed by a brisk rub. Massage is also to be recommended. The patient should be frequently taken out driving or walking; the appetite should be improved and the patient encouraged to eat as much as possible. The bowels should be regulated and tonics, such as quinine, iron, nux vomica and arsenic given. Galvanism to the spine is usually beneficial.

SPINA BIFIDA.

This is a congenital defect, due to the failure of union of one or more of the vertebral arches. The process is usually associated with protrusion of the spinal membranes or cord in the form of a tumor or sac. The sac contains cerebro-spinal fluid. The spinal cord has its origin from the epiblast which grows into the deeper structures as a linear medullary fold. The borders of this linear fold grow upwards, and, coalescing in the median line, form the central canal of the cord. The cord is subsequently separated from the overlying skin by an intrusion of the mesoblast, which forms the vertebræ, spinal membrane, ligaments and muscles.

The following varieties of spinal bifida are described:

1. Myelocele. This form results from a want of closure of the primitive medullary groove. The defect occurs in the lumbo-sacral region. There is here to be seen a raw surface, representing the structures of the exposed spinal cord. The central canal of the spinal cord opens at the upper border of the red area. Infants with this deformity are either stillborn or survive but a few days.

2. Syringomyelocele. In this variety the central canal of the cord is distended with fluid and forms a tumor which projects posteriorly from the spinal canal. The cord is intimately associated with the sac, having never been separated from it by an ingrowth of the mesoblast. The spinal nerves pass out of the foramina, from the sides of the sac. This form of spina bifida is rare.

3. Meningomyelocele. In this form there is a deficiency in the arches associated with protrusion of the spinal cord and membranes. The sac is made up of skin and dura, and lined by the arachnoid membrane. The cavity of the sac is in direct relation with the subarachnoid space. The cord leaves the canal and crosses to the posterior wall of the sac where it spreads out. From this position the nerves cross the sac to the intervertebral foramina. This form comprises about 65 per cent. of all cases of spina bifida.

4. Meningocele. In this form only the membranes protrude. The deficiency in the arch is not great and the sac tends to become pedunculated, and in some cases the opening between the sac and the canal is obliterated (Figs. 448 and 449).

5. Spina bifida occulta. Here there is a defect in the spinal arches

Fig. 448.—Meningocele of lower lumbar and sacral region.

without protrusion of the membranes, or cord. In this form there are frequently found other congenital defects, such as club foot; or it may have as its only apparent manifestation a growth of hair along the spine, corresponding to the openings in the laminæ.

CLINICAL HISTORY.—Myelocele: this condition is incompatible with life in consequence of the constant leakage of the cerebro-spinal fluid.

In syringomyelocele, meningomyelocele and meningocele there is usually a protrusion of either the membranes or cord, or both, through the gap in the spinal column. The swelling varies in size and may be not larger than an English walnut, or as large as a fetal head. It is round or oval in shape, and occasionally lobulated as the result of partitions. It is situated in the median line and is often pedunculated or slightly contracted at its base. The tumor is soft and fluctuant. It becomes more tense on crying

or straining, and compression of the tumor often causes dizziness, prominence of the fontanelles, or even unconsciousness. The growth is usually only partially covered by normal skin, the uncovered portion being red and raw, or bluish and thin, and representing only the membranes of the spinal cord. The deficiency in the spinal arches can usually be made out. Any portion of the spine may be affected, but the lumbo-sacral region is most frequently the site of the defect. The general health of the child may be good, but as a rule it is very poor. If the cord is involved, there is likely to be disturbance of the functions of the bladder and rectum, and probably paralysis or paresis of the lower limbs.

Diagnosis.—This will rest upon the following conditions: the tumor is congenital, in the median line, fluctuates and its tensity increases on straining or crying. If compressed or partially reduced it increases the intracranial pressure. The skin covering is often deficient. It grows up from the sides, leaving the central portion raw, uncovered and composed

Fig. 449.—An immense meningocele involving the sacrum.

only of the membranes of the cord. The opening in the arches can usually be felt. The tumor as a rule, quite rapidly increases in size.

Prognosis.—In some cases a spontaneous recovery is attained. This is only possible in meningocele where the connection between the sac and the spinal canal becomes shut off by the growth of the laminæ. In the great majority of cases the growth of a spina bifida is progressive. Ulceration and rupture of the sac may occur, or infection with or without a rupture, which reaches the membranes within the canal and the cord, either condition ending in death.

In the great majority of cases the children die of marasmus.

Treatment.—The sac of a spina bifida following birth should be kept scrupulously clean, enveloped in absorbent gauze and cotton, and supported by a bandage. This treatment should be continued at least for several weeks until the child has developed some power of resistance. In cases of syringomyelocele no other treatment is permissible. In cases of meningomyelo-

cele, and especially in cases of meningocele, if the condition is progressive, after the child has gained sufficient strength, the sac may be injected with Morton's fluid, which consists of 10 grains of iodin and 30 grains of iodide of potash to the ounce of glycerin. Under strict antiseptic precautions, and either with or without the withdrawal of a small quantity of the fluid, from 20 to 30 drops of this solution may be injected into the sac. The needle should enter the base of the tumor, and preferably where it has a normal skin covering. The opening may then be closed with collodion. Following the injection the tumor should be supported as before, and after the reaction has subsided, if the tumor has decreased in size, the injection may be repeated in periods of eight or ten days. If the injections are not beneficial, or not thought advisable, resection may be practised.

In resection, the parts should be thoroughly asepticized, the child placed upon its side and abdomen, in an exaggerated Trendelenburg position, and lightly anesthetized, when two curvilinear incisions are made around the base of the tumor, leaving sufficient skin, if possible, to cover the defect when the tumor has been removed. The skin flaps are dissected away from the membranes and when the base is reached in a case of meningocele this may be transfixed with catgut and tied off as the fluid is allowed to escape. The redundant portion of the sac is then cut away and its surfaces united carefully and accurately with a continuous suture, so as to prevent absolutely any leakage of cerebro-spinal fluid. Following this the flaps of skin are accurately approximated. In cases in which there is not a sufficiency of skin to cover the defects, the flaps may be taken from the lumbar region and swung into position. In cases of meningomyelocele in which the cord is situated upon the posterior surface of the sac, the sac should be opened, the fluid allowed to drain off, the cord separated from the sac and replaced within the canal, when that portion of the sac which is in excess is cut away and its surfaces accurately approximated by continuous catgut sutures. The skin flaps are then united with silkworm gut, and a compress and large dressing applied, supported by a well-fitting bandage. It is best to keep the child in the Trendelenburg position for a week or ten days, in order to prevent undue pressure or tension upon the sutured surfaces. The results of excision in suitable cases have been quite satisfactory, although the dangers are considerable, and these consist in the continued leakage of cerebrospinal fluid, shock, convulsions and septic meningitis.

CHAPTER XXIV.

AMPUTATIONS.

By this is understood the removal of a limb or portion of a limb through its continuity. Disarticulation or exarticulation, is the removal of a limb at a joint.

Indications.—Any injury, disease or malformation which renders the retention of a limb prejudicial to the life, health or comfort of the individual is an indication for amputation.

Amputation is frequently required in severe crushing injuries, as in railroad and machinery accidents, in which the soft parts are lacerated, the bones crushed and the circulation interfered with.

Amputation is frequently required in gangrene of a limb, in malignant disease, and in some cases of severe and uncontrollable infection.

Amputation may be required in cases of compound fracture in which the bones have been greatly comminuted and the injury followed by severe infection, likewise in some cases of compound dislocation followed by infection. There are, however, very few injuries, including compound fractures and dislocations, in which the circulation is maintained and progressive infection prevented, which require amputation. In some cases of deformity, where the limb is useless and a burden for the patient, amputation is indicated.

Gunshot injuries, extensive bone disease, elephantiasis and aneurism will occasionally call for amputation.

A limb should at any time be sacrificed to save a patient's life. An amputation, however, should never be performed if the limb will be of use to the patient and can be saved. It is also a cardinal rule in surgery to preserve as much of the limb as possible, and this rule is especially applicable to amputations about the hands and feet. In consequence of the present methods of combating and controlling infection, amputations are much less frequent than formerly.

Preparation of the Patient.—Amputations are frequent in emergency cases where the preparation must be hurriedly made. The limb, however, should be shaved, thoroughly scrubbed, dried, washed with alcohol, and then with some antiseptic solution, such as bichloride of mercury, carbolic acid or lysol. A wet antiseptic dressing may then be applied and retained until the preparations for the operation are complete. In accident cases the patient upon reception may, with advantage, be given 1-30 of a grain of strychnine, and 1-4 of a grain of morphine. In other cases these remedies should be given before the administration of the anesthetic.

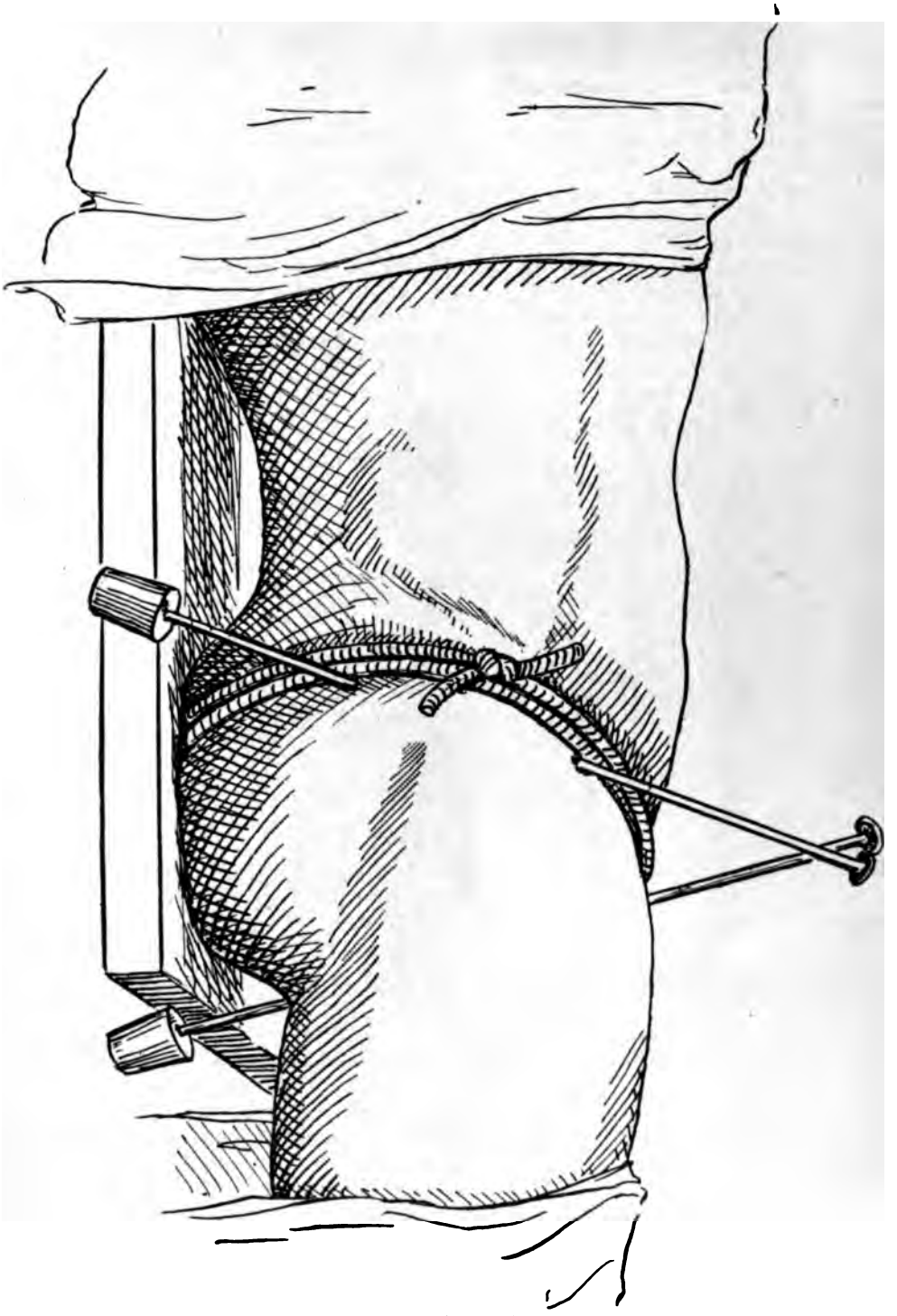


Fig. 450.—Wyeth's method of controlling hemorrhage in disarticulation at the hip.

contract reflexly. The rubber bandage should not be firmly applied over a malignant growth or the seat of a superficial infection, for fear of forcing these products into the veins.

Hemorrhage may also be controlled by digital compression of the main artery, or by the use of the tourniquet, consisting of a pad which is screwed down upon the main artery and held in place by a strap encircling the limb.

In amputations at the hip or shoulder Wyeth's method of controlling hemorrhage is to be recommended. For the hip, this is carried out as follows (Fig. 450): The requisites are, a piece of strong rubber tubing one-third of an inch in diameter, two yards long, and two steel needles two-sixteenths of an inch in diameter and eight inches long. The limb is first elevated for three minutes, for the purpose of rendering it as nearly as possible avascular; one needle is then inserted just below, and at the inner side of the anterior-superior spine of the ilium, and made to traverse the muscles

Fig. 452.—Method of controlling hemorrhage without the use of pins.

and fascia on the outside of the limb, and emerge on a level with, and from three to four inches external to, the point of entrance. The second needle enters the tissues just internally to the saphenous opening and one-half inch below Poupart's ligament and emerges one inch below the tuberosity of the ischium. The sharp points of the needles should be protected by corks, to prevent injury to the surgeon's hands. The rubber tubing is now tightly wound three or four times about the limb, above the needles, and knotted, or its ends held with a pair of forceps.

Jordan Lloyd's Method.—The limb is elevated as before for three minutes. A pad is then placed over the external iliac artery, a strip of bandage laid down the anterior surface of the limb, and another down the posterior surface. The tubing is then carried strongly about the hip for several turns, crossing the crest of the ilium above, and passing between the anus and the tuberosity of the ischium below. With the last turns the tubing is crossed

at the iliac crest, carried about the body and knotted. Then by drawing upwards upon the bandages the tubing is kept in place and prevented from slipping down upon the thigh. If the foregoing precautions are not taken, as soon as the head of the bone is disarticulated, the tubing will slip down over the flaps, and while obstructing the surgeon's view, will not control the hemorrhage.

I have used the Wyeth's method in four cases of disarticulation at the hip, without having a single vessel spurt.

By these methods either the common femoral or the external iliac is compressed against the rim of the pelvis anteriorly, while the gluteal, sciatic and internal pubic are compressed against the border of the pelvis posteriorly.

Wyeth's Method of Controlling Hemorrhage at the Shoulder.—In this method a steel pin is made to enter the middle of the anterior axillary fold and emerge one inch internally to the tip of the acromion process. The second pin enters the middle of the posterior axillary fold and emerges just within the tip of the acromion process (Fig. 451). Above these pins a

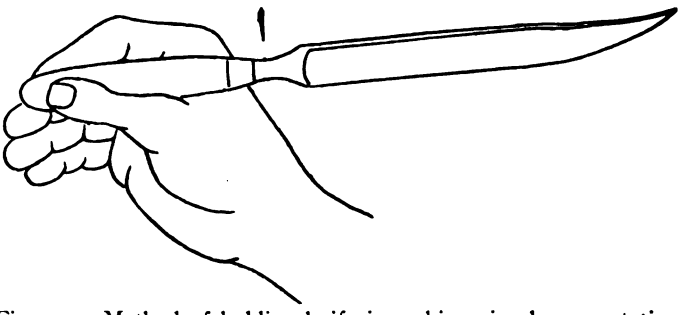


Fig. 453.—Method of holding knife in making circular amputations.

strong piece or rubber tubing is drawn and knotted. (Fig. 452 shows method of controlling hemorrhage without pins.)

GENERAL TECHNIC OF AMPUTATIONS.

THE FORMATION OF FLAPS.

Flaps may be made by the circular method or by forming equal or unequal lateral or antero-posterior flaps. The flaps should be of such length as to cover the ends of the bones freely and without tension. If the flaps are too short, a conical and painful stump will be produced, or the bone may protrude between the flaps, making a resawing of the bone, or a second amputation necessary. Flaps formed from the lower portion of the arm, and especially from the lower third of the thigh, must be proportionately longer than those taken from the forearm or leg, in consequence of the length and greater contraction of the severed muscles. As a rule, the flaps taken together must be equivalent to one and one-half diameters of the limb at the sawline; and each flap, when of the same length, whether bilateral or belonging to a cuff, should be equal to three-quarters of the diameter of the limb. Flaps of proper shape and length may be marked on the skin

much as one would an inverted penholder (Fig. 453), while with the left hand he retracts the skin above the proposed line of incision, then stoops and carries his arm beneath and over the limb, applying the heel of the knife to its anterior surface (Fig. 454). The incision is commenced with a slight sawing motion and the knife carried completely around the limb to the point

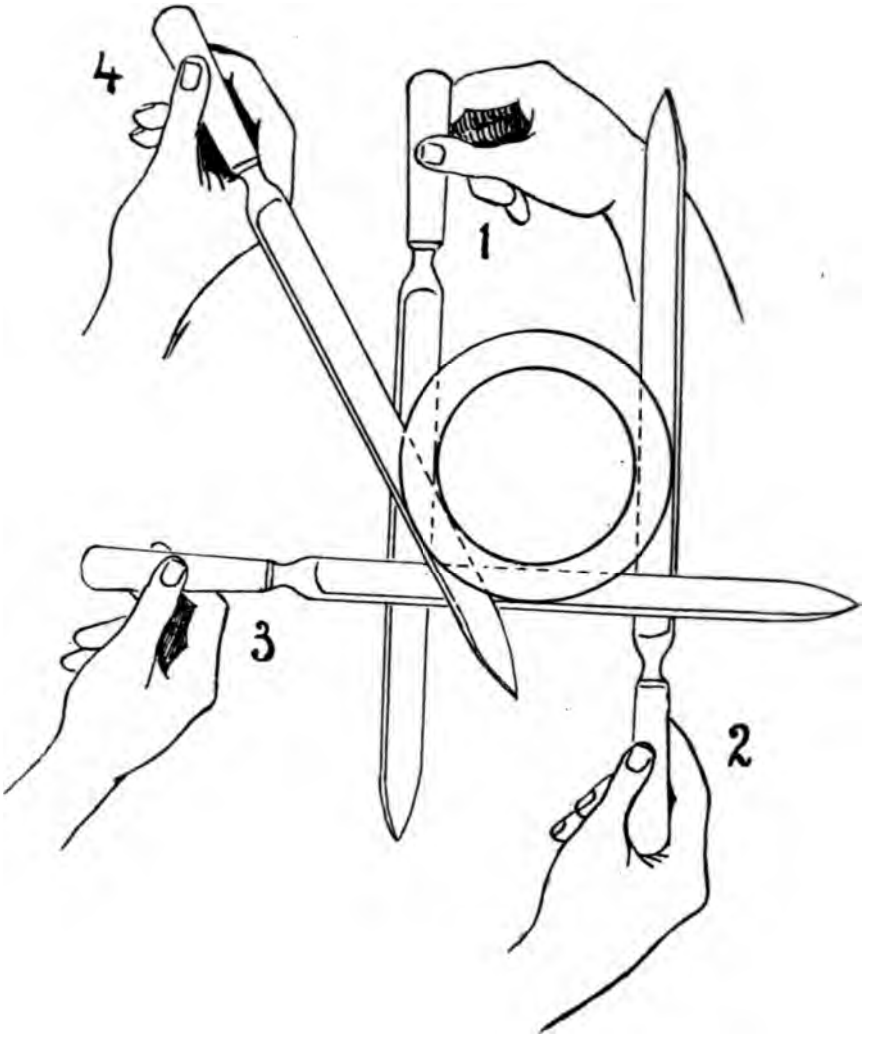


Fig. 455.—A different method of holding the knife in making a circular amputation.

of starting, without changing the hand. This is readily accomplished if the thumb and forefinger grasp the handle of the knife near its extremity, so that in making the incision around the limb the handle of the knife can pass between the base of the thumb and index finger (Fig. 455). Incision made by passing the arm over the limb). The first incision divides the skin and

fascia down to the muscles. This cuff is then dissected back from the muscles for one or two inches, depending upon the size of the limb, when the second circular incision is made close to the cuff and through the superficial layer of muscles (Figs. 456 and 457). These muscles are now retracted and a third circular incision made, which goes to the bone. It is now necessary to retract all of the tissues well upward above the sawline. This is done

Fig. 456.—First incision dividing skin and fascia.

in the arm and thigh by taking a piece of sterilized cotton cloth, one yard wide and tearing one end down half way. The termination of the slit is then made to surround the bone, the two ends crossing the soft tissues in front, and the untorn end crossing them behind. If the two extremities are now drawn upon strongly, the cuff can be retracted out of the way of the sawline (Figs. 458, 459, 460, 461 and 462).

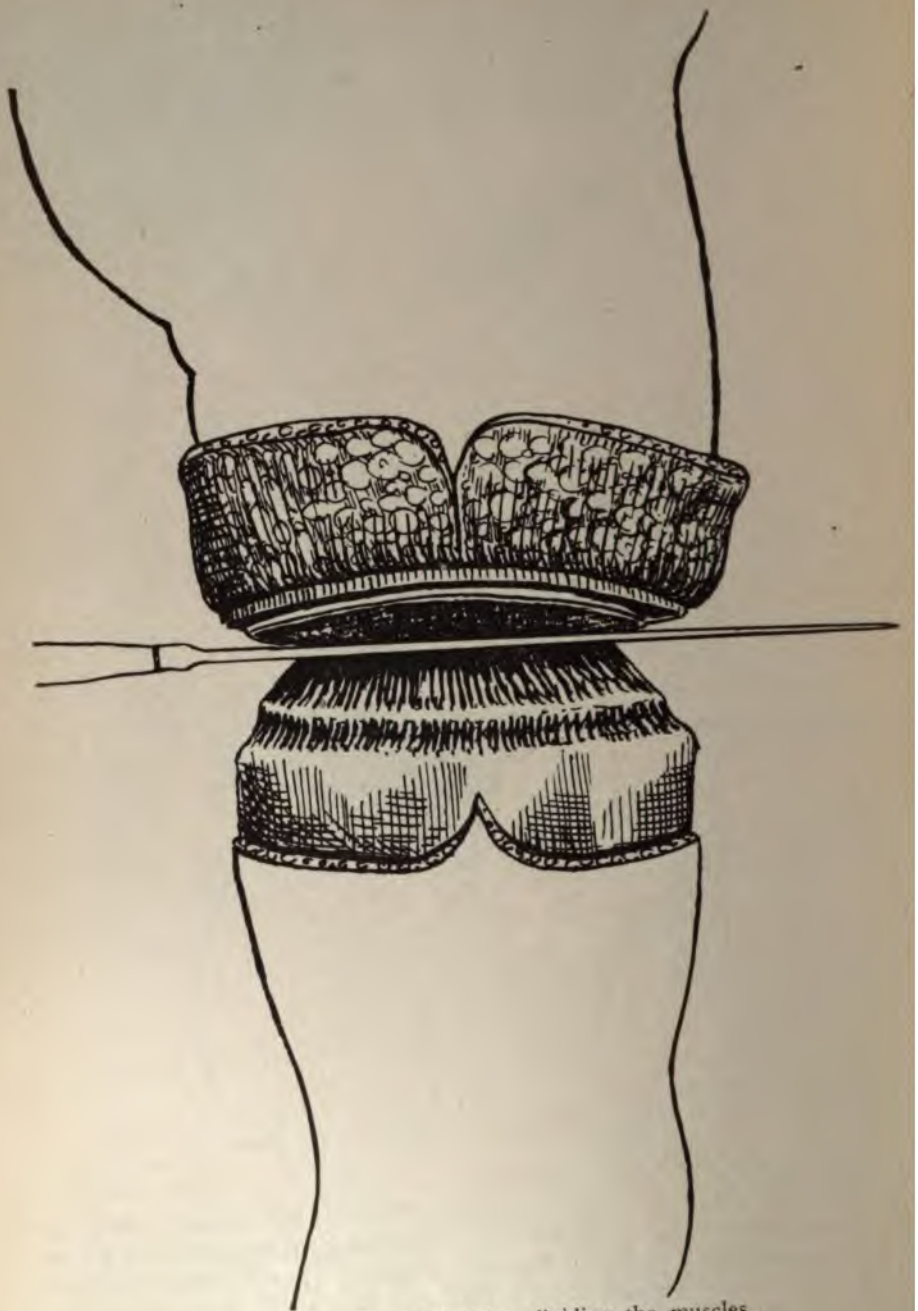


Fig. 457.—Second incision dividing the muscles.

Fig. 457b.—Stump in circular method.

Fig. 458.—Cloth retractor where there is but one bone.

In amputations through the shaft of a bone, it is desirable to have a periosteal or musculo-periosteal covering for the end of the bone. This should be about equal in length to the diameter of the shaft. A circular incision is made about the bone and through the periosteum, and the flap pushed back to the proposed sawline with the handle of a scalpel or a periosteal ele-

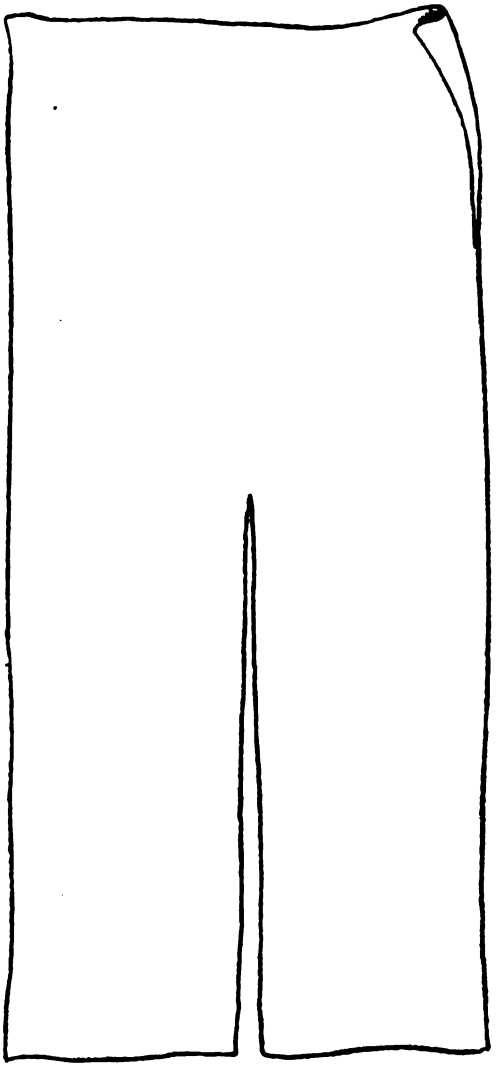


Fig. 459.—Retracting the soft tissue where there is but one bone.

vator. After the bone is sawn the periosteal flap is allowed to fall over the end of the bone. The advantages of a periosteal flap are that it lessens the liability to necrosis, osteomyelitis and the fixation of the soft tissues to the end of the bone, the latter when it occurs making a painful stump. The

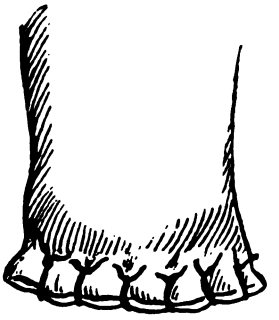


Fig. 457b.—Stump in circular method.

58.—Cloth retractor where there is but one

Edmunds have established the fact that in ligating a vessel the ligature should only be drawn sufficiently tight to approximate the internal coats of the vessel and not to divide them, as was formerly thought necessary. In cases of arterio-sclerosis it is often desirable to apply a second and even a third ligature upon important vessels, these ligatures being placed parallel and in immediate juxtaposition. When the main vessels have been ligated the constricting band is loosened and then removed, all bleeding vessels caught with forceps and ligated. The important nerves are then seized with

Fig. 461.—Method of applying retractor where there are two bones.

forceps, drawn out two or three inches, and cut off. This is done for the purpose of preventing them from being caught in the cicatrix or irritated by any possible subsequent infection. After the control of hemorrhage and the retrenching of the nerves, the periosteal flaps are brought together by one or two catgut sutures and the skin and subcutaneous tissues by interrupted silkworm gut sutures. Usually a small tube or a few strands of catgut are introduced for drainage, which ordinarily needs to be maintained

only for a few days. In amputations through the lower third of the thigh it may be necessary, in order to prevent too great contraction of the muscles and retraction of the flaps, to make extension from the parts. This may be accomplished by applying on each side of the limb a strip of ad-

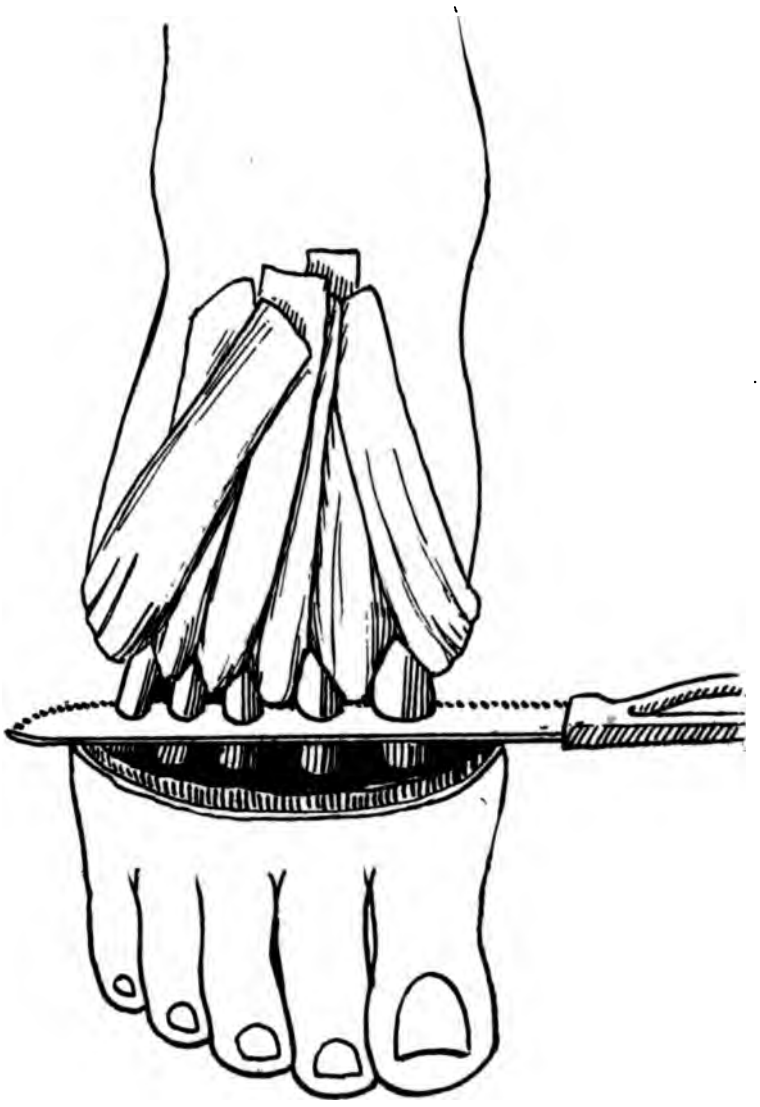


Fig. 462.—Many-tailed retractor.

hesive plaster, which is held in place by a bandage. These strips extend over the end of the stump, where they are knotted and a weight is attached by a cord which runs over a pulley. A large dressing is then applied, secured by

only for a few days. In amputations through the lower third of the thigh it may be necessary, in order to prevent too great contraction of the muscles and retraction of the flaps, to make extension from the parts. This may be accomplished by applying on each side of the limb a strip of ad-

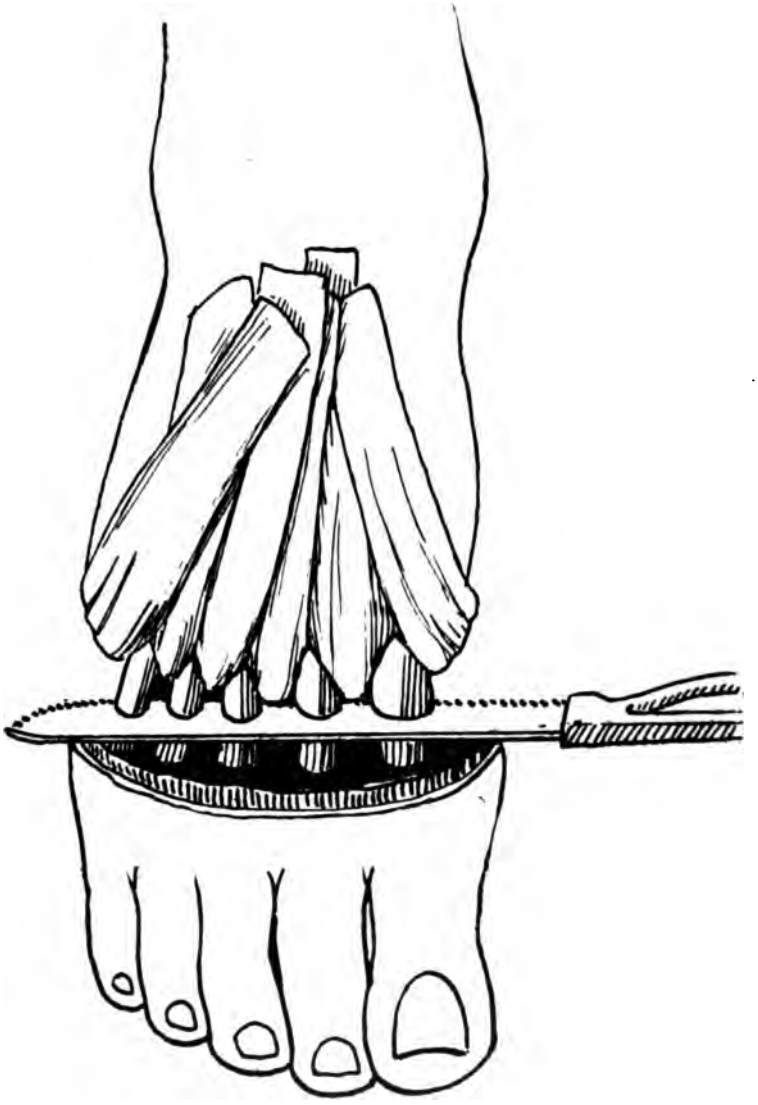


Fig. 462.—Many-tailed retractor.

hesive plaster, which is held in place by a bandage. These strips extend over the end of the stump, where they are knotted and a weight is attached by a cord which runs over a pulley. A large dressing is then applied, secured by

a bandage. In applying a bandage for the purpose of securing dressings to an amputated thigh or arm, it is usually necessary to carry the bandage around the waist or chest in order to prevent its slipping off. In amputations of the forearm or leg, the bandage may be carried up over the elbow or knee for the same purpose.

In perhaps the majority of cases the modified circular, mixed or bilateral flap method of amputation will be found most suitable.

Fig. 463.—Formation of a periosteal flap.

Technic.—The technic of this method is as follows: two equal lateral or antero-posterior flaps are made, whose combined length equals one and one-half diameters of the limb. These flaps include the skin and fascia down to the muscles, and are made with a good-sized scalpel by cutting from without inwards. If the surgeon is ambidextrous and the amputation through the forearm or leg, he stands facing the limb, and while holding the knife in the right hand an incision is commenced in the center of the an-

terior surface of the limb and carried across the left side, so as to make a flap slightly convex below. On reaching the posterior aspect of the limb the incision is carried upwards to the center line and to the point where the bone is to be sawn. The knife is now transferred to the left hand and a similar flap made on the right side of the limb. These flaps are dissected up one inch for the leg and two inches for the thigh, retracted, and a circular incision made with a long knife through the superficial muscles. These

Fig. 464.—Modified circular or mixed method.

muscles are retracted for perhaps one inch and a second circular incision made, which goes to the bone. The periosteum is then divided by a circular incision, pushed upwards for about one inch and the bone sawn. If there are two bones of unequal size, as in the leg, the smaller one should be sawn through first and at a somewhat higher level than the larger one (Fig. 464).

muscular tissue involved; or if practised in the thigh the flap should not be completely retracted, and two circular incisions made, the first including the superficial and the second the deep muscles (Fig. 464).

AMPUTATION BY A SINGLE FLAP OF SKIN AND FASCIA OR BY UNEQUAL FLAPS.

In some cases of accident or disease one surface of the limb will be

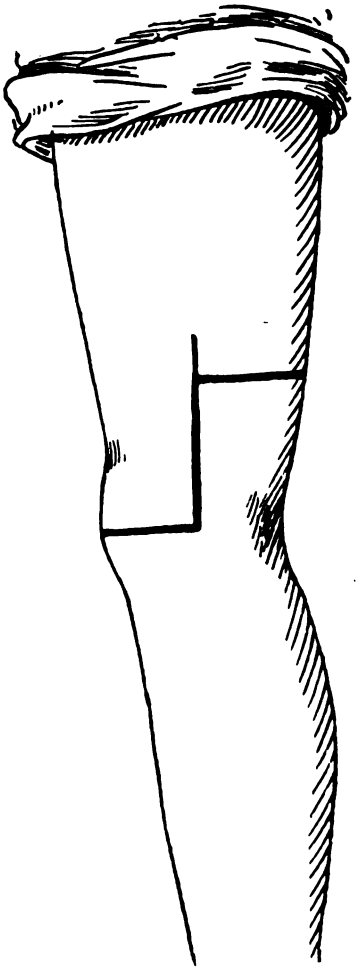


Fig. 466.—Amputation by a single flap. Teale's method.

healthy, while the other is lacerated or diseased. In these cases in order to save as much of the limb as possible it is desirable to take the major portion or all of the flaps from the healthy side. If there are two unequal flaps the lower borders are usually cut convex, while if but a single flap is made this is usually cut rectangularly. It includes one-half the circum-

fixion are lifted up from the bone by the hand. The flap is then cut the requisite length, from above downwards and outwards, by a sawing motion of the knife. The upper flap is then turned upwards, the knife re-entered at the sawline, passing behind the bone, and the lower flap cut of the same length as the upper. A periosteal flap is then made and the bone sawn (Figs. 468 and 469).

In all musculo-cutaneous flaps, after securing the blood vessels and retrenching the nerves, the flaps should be united by quilted sutures of catgut. Over these the skin and fascia are brought together by silkwormgut (Fig. 470). Musculo-cutaneous flaps are also made by cutting from without inwards. A large scalpel is ordinarily used, the flaps being marked out and cut as in making skin flaps. But instead of reflecting the deep fascia

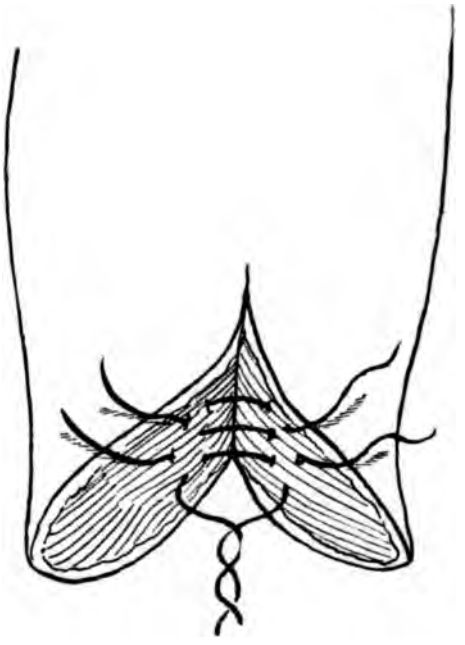


Fig. 470.—Quilting the flaps.

from the muscles, the incisions are continued through the muscles upward and toward the bone until the sawline is reached. In the same manner a similar flap is formed upon the opposite side of the limb. When the conditions are favorable, musculo-cutaneous flaps of unequal length, or a single musculo-cutaneous flap, may be formed.

ELLIPTICAL METHOD.

This is a modified flap method and is suitable for amputation through the forearm and leg when the flap is to be taken from one surface of the limb. The incisions are in the form of a lozenge or ellipse, the upper end of the ellipse being on one side of the limb and the lower on the other, the

two arms of the ellipse crossing the lateral aspects of the limb (Fig. 471).

Technic.—For purposes of illustration we will suppose that the left arm is to be amputated at the elbow, and the flap taken from the anterior

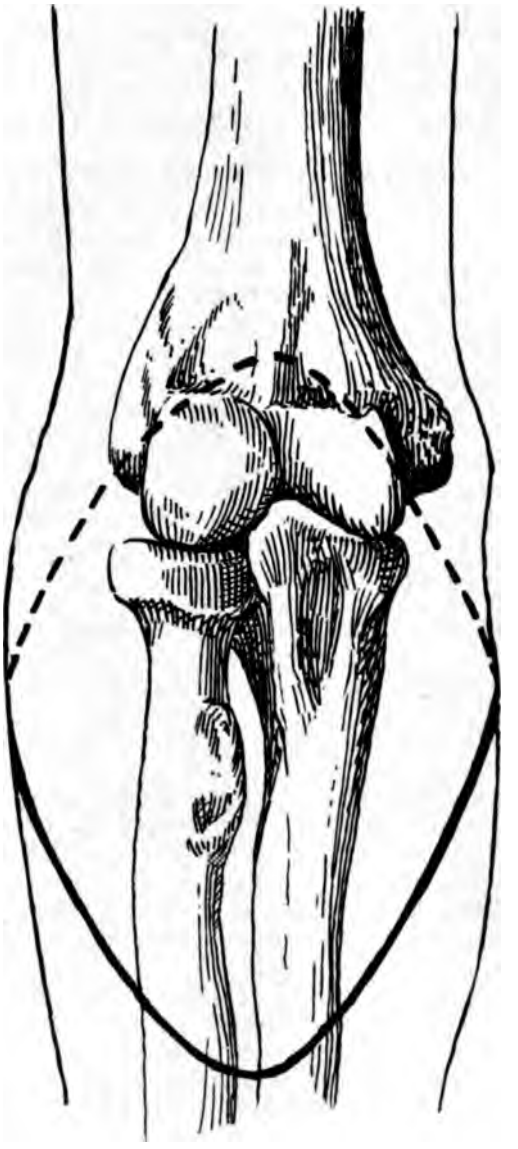


Fig. 471.

surface of the forearm. The incision is commenced posteriorly on the outer side of the arm, just above the sawline, and carried downwards and forwards across the side of the arm so as to form a flap in length equal

to one and one-half diameters of the limb. It is then continued across the front of the forearm, forming a convex flap, and upwards and backwards on the internal surface of the arm to the sawline; an incision concave below is then carried across the back of the arm to the point of starting.

This flap is now raised from the anterior surface of the forearm up to the sawline. The muscles upon the posterior aspect of the arm are cut transversely and the bones sawn. The flap is then turned backwards and stitched into position.

CHOICE OF METHODS OF OPERATION.

The method selected should (1) sacrifice the least amount of healthy tissue; (2) give a good bone covering; (3) afford flaps with a good blood supply; (4) give a favorably situated cicatrix; (5) leave a stump to which an artificial limp may readily be adjusted.

The circular method sacrifices the least amount of bone, the cicatrix is terminal, and the stump may become conical. A circular amputation is quickly performed but the bone is not always easily exposed.

The flap method gives good covering to the bone, the cicatrix may be placed terminally or laterally, the bone is readily exposed to the sawline, and the stump is not likely to become conical. The amount of tissue sacrificed is somewhat greater than in the circular method.

The death rate in amputation is proportionately greater the nearer the amputation is to the trunk. It is always greater in the lower than in the upper extremities; in men than in women; for injury than for disease; and greatest between the ages of five and fifteen.

Qualities of a Good Stump.—The stump should be regular, firm, so that the bone will be non-sensitive, while the skin is non-adherent except at the cicatrix, flaps well nourished and the cicatrix able to withstand pressure.

Characteristics of a Bad Stump.—Flaps scanty, tightly drawn, adherent to bone, sensitive, poorly supplied with blood, irregular or conical; often the site of ulceration and callus, or papillomatous formations.

Changes in the Stump.—The skin contracts about one-third the length of the flap; the contraction is greatest where the skin is thinnest; when there is but loose attachment to subcutaneous parts, or the subcutaneous tissue is slight in amount. When the process of healing has been delayed the contraction of muscles may be but slight, or equal to one-half of their length.

The muscular tissue in a stump usually disappears and is replaced by fibrous tissue and fat, which pad the stump and thus serve a useful purpose.

Bones.—The bones undergo atrophy and the ends become conical. The medullary canal is closed by the formation of new bone, or by fibrous tissue. In some cases, as the result of periostitis and ostitis, new osseous tissue is formed and the end of the bone becomes large, irregular, nodular and club-shaped.

Nerves.—The nerves undergo atrophy and the ends become bulbous. The bulbs are made up in the main of fibrous tissue, and the size of the bulbs depends largely upon the amount of irritation to which they are subjected.

the ellipse crossing the lateral aspects of
.—For purposes of illustration we will
amputated at the elbow, and the flap tak

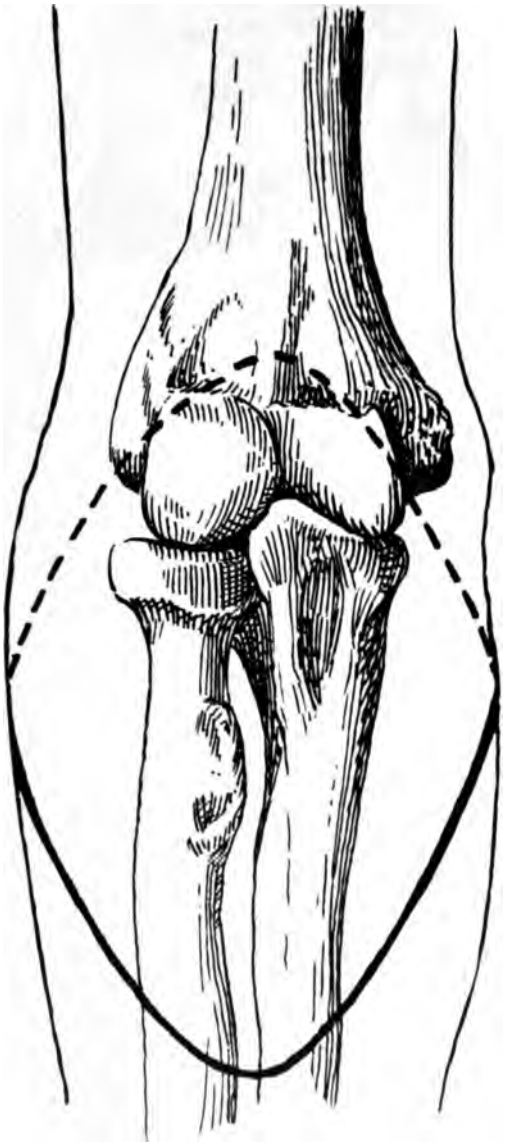


Fig. 471.

arm. The incision is commenced poste
m, just above the sawline, and carried d
side of the arm so as to form a flap ir

AMPUTATION THROUGH THE TERMINAL PHALANGES.

The patient is anesthetized and the hand supported by an assistant, who holds the other fingers out of the way. The hand should be supinated during the formation of the palmar, and pronated during the formation of the dorsal, flap. The surgeon holds the part to be removed between the thumb and forefinger of the left hand.

Formation of the Palmar Flaps This flap should equal in breadth one-half of the circumference of the finger at the sawline. The incision is commenced on the lateral aspect of the finger and just in front of the base of

Fig. 473.—B. Disarticulation at the metacarpo-phalangeal joint—racket method. a and c. Removal of finger or thumb with its metacarpal bone.

the phalanx, and carried down the side of the nail to near the tip of the member, when it is carried around the end of the finger and up the opposite side to the sawline. This flap is dissected up, taking all of the tissues down to the bone. A transverse incision slightly convex below is then made across the dorsum of the finger, and connects the extremities of the two lateral incisions already made. The bone is cleared and divided with forceps or saw. The divided flexor tendon is then secured to the sheath, periosteum, glenoid ligament or flap, and the sheath closed. The palmar flap is brought

upward and stitched to the dorsal flap by two or three sutures. Dressings are then applied and the finger supported on a short palmar splint.

DISARTICULATION THROUGH THE SECOND INTERPHALANGEAL JOINT.

This operation is more frequently done than amputation through the terminal phalanx. The technique is practically the same. The lateral incision commences at the joint line midway between the dorsal and palmar surfaces, and is carried down the side for a little more than one diameter of the finger. It is then carried around the end and up the other side, to the articulation. The flap is then dissected up to the joint line, taking all of the tissues down to the bone. A dorsal incision slightly convex below is then made, connecting the extremities of the two lateral incisions. The joint is opened and the end of the finger removed. The deep flexor is secured to the flap, the sheath or periosteum, and the sheath closed. The palmar flap is brought up over the end of the finger and secured to the dorsal by two or three stitches, and proper dressing applied (Fig. 472).

AMPUTATION THROUGH THE SECOND PHALANX BY SHORT DORSAL AND LONG PALMAR FLAP.

The technic in this operation is practically the same as in the one just described. The incision for the palmar flap should commence at the sawline and be carried down the side the distace equal to one diameter of the finger. It is then carried across the palmar surface and up the other side to the sawline. The flap is dissected up, taking all of the tissues to the bone. The dorsal flap should equal nearly one-half the diameter of the finger and is formed by making an incision across the dorsum of the finger, convex below, and connecting the two lateral incisions.

All of the soft tissues are now reflected to the sawline, the bone divided and the finger removed; and the superficial flexor, if divided, should now be secured to the periosteal flap or tendon sheath. The palmar flap is turned over the end of the finger and secured by two or three stitches to the dorsal. Ordinarily in finger amputations the digital arteries do not require ligation (Fig. 472).

DISARTICULATION OF THE INTERPHALANGEAL JOINT.

The technic of this operation is the same as that already described for amputation through the second phalanx.

DISARTICULATION OF A FINGER OR THE THUMB AT THE METACARPO-PHALANGEAL JOINT.

The oval or racket incision is the one usually employed. A perpendicular incision is commenced on the dorsum of the hand, just above the joint and goes downwards in the median line as far as the lower border of the web, when the incision bifurcates and is carried across each side of the digit so as to make convex flaps, and then transversely across the palmar surface. The palmar incision goes to the bone, the flaps are dissected up, the extensor tendons divided and the joint opened during strong flexion of the member. The lateral ligaments are divided and the finger removed. The digital arteries are ligated if they do not readily cease bleeding, and the synovial sheath closed by one or two catgut sutures. If it is desired

to remove the head of the metacarpal bone in order to make the hand more shapely, the incision over the dorsum should be carried further upwards and the flaps cut shorter. In these cases after disarticulating the finger, the head of the bone is freed and then removed with bone forceps or with a saw. In laboring people the head of the metacarpal bone should not ordinarily be removed, as its presence adds material strength to the hand (Fig. 473b).

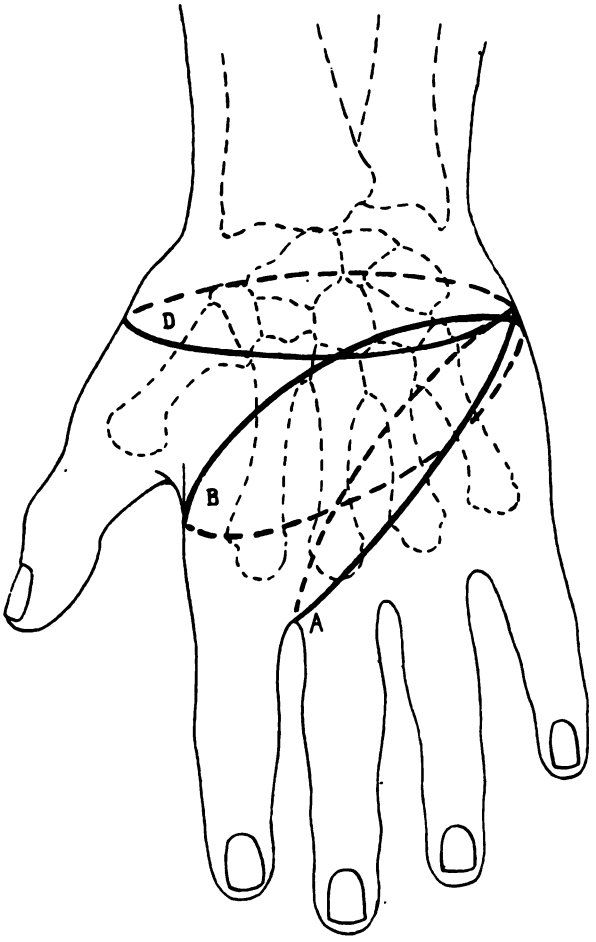


Fig. 474.—A. Removal of three outermost fingers. B. Removal of all the fingers. D. Disarticulation at the carpo-metacarpal joints.

GENERAL CONSIDERATIONS IN AMPUTATIONS ABOUT THE HANDS.

A finger may be removed with a part of or the entire metacarpal bone. It is ordinarily best to remove the entire metacarpal bone corresponding to the thumb or little finger, in preference to a part, as the remaining portion is of no particular advantage to the hand, and being on the outside its end is apt to be in the way and cause irritation of the over-

lying tissues. With the middle fingers it is ordinarily best to remove but a portion of the metacarpal bone, as the portion remaining is not in the way and strengthens the hand somewhat.

In amputations through the metacarpals, the deep palmar arch is less likely to be injured than in carpo-metacarpal disarticulations, while the synovial sacs corresponding to the latter joints are not disturbed (Fig. 473c).

AMPUTATION OF FINGERS OR THUMB WITH A PART OF METACARPALS. (RACKET METHOD.)

The incision should commence upon the dorsum just above the proposed sawline, and pass downwards over the center of the bone to its neck.

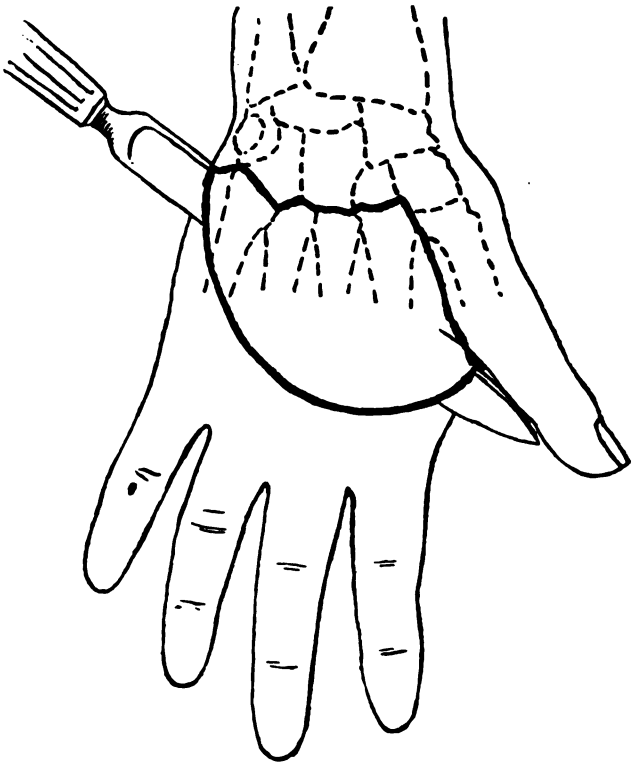


Fig. 475.—Disarticulation of all the fingers at the carpo-metacarpal joints. Palmar flap.

From this point incisions are carried over each side of the finger through the attachments of the web, and across the palmar surface in a transverse direction. The latter incision goes to the bone. These incisions can be made with one or at most two sweeps of the knife. The incisions are then deepened, keeping the knife close to the bon. The metacarpal bone is exposed, and at the proper point divided. The entire metacarpal bone may be removed by extending the incision up as far as the carpo-metacarpal articulation, where disarticulation is affected.

to remove the head of the metacarpal bone in order to make the hand more shapely, the incision over the dorsum should be carried further upwards and the flaps cut shorter. In these cases after disarticulating the finger, the head of the bone is freed and then removed with bone forceps or with a saw. In laboring people the head of the metacarpal bone should not ordinarily be removed, as its presence adds material strength to the hand (Fig. 473b).

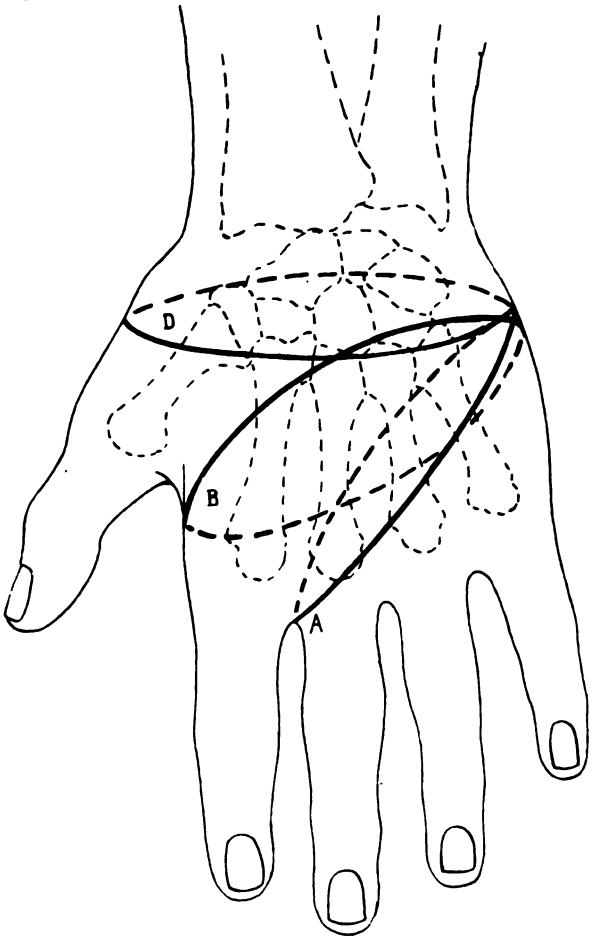


Fig. 474.—A. Removal of three outermost fingers. B. Removal of all the fingers. D. Disarticulation at the carpo-metacarpal joints.

GENERAL CONSIDERATIONS IN AMPUTATIONS ABOUT THE HANDS.

A finger may be removed with a part of or the entire metacarpal bone. It is ordinarily best to remove the entire metacarpal bone corresponding to the thumb or little finger, in preference to a part, as the remaining portion is of no particular advantage to the hand, and being on the outside its end is apt to be in the way and cause irritation of the over-

and index finger, being convex below. [illegible] and terminates at the same point, but is [illegible] the convex palmar flap will fit into the [illegible] deepened to the bones, the tendons cut long [illegible] lations exposed, the dorsal ligaments divided while [illegible] the palmar ligaments divided while the hand is [illegible] part is then removed, any vessels which bleed are [illegible] extensor tendons are sutured to their respective [illegible]

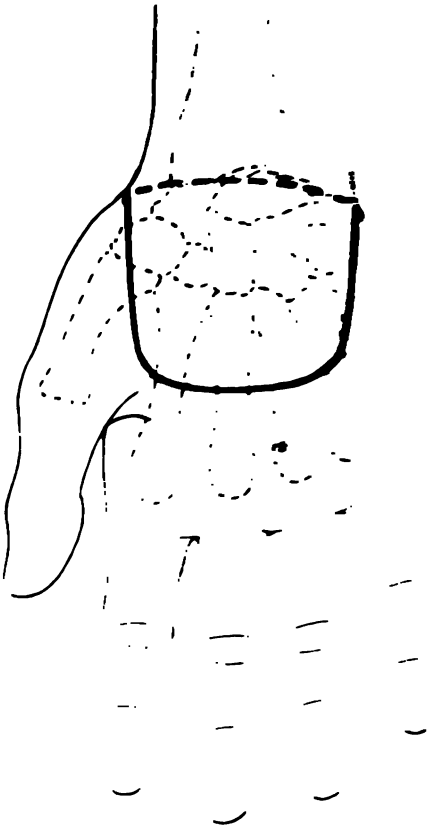


Fig. [illegible]—Palmar flap in disarticulation [illegible]

[illegible] suture the palmar flap brought [illegible] the [illegible] the palmar flap [illegible] while the [illegible] convex bel[illegible]

DISARTICULATION OF THE FINGERS AND THUMB

CARPO-METACARPAL DISARTICULATION

The principles of this operation are the same as in the one just [illegible] The palmar incision is commenced just below the base [illegible]

fifth metacarpal bone and carried downwards and outwards to just below the base of the metacarpal bone of the thumb. The flap is convex below. The dorsal flap commences and terminates at the same point, and is slightly concave below. The incisions are deepened, the tendons divided and disarticulation effected. Bleeding points are secured, the tendons stitched into their respective flaps and the tendon sheaths closed. The flaps are then united by interrupted sutures (Fig. 474d).

DISARTICULATION OF THE WRIST JOINT.
ANTERIOR ELLIPSE OR PALMAR FLAP.

The wrist joint is readily outlined by projecting a straight line between the styloid processes of the radius and ulnar. The highest point of the articulation is one-half an inch above this line.

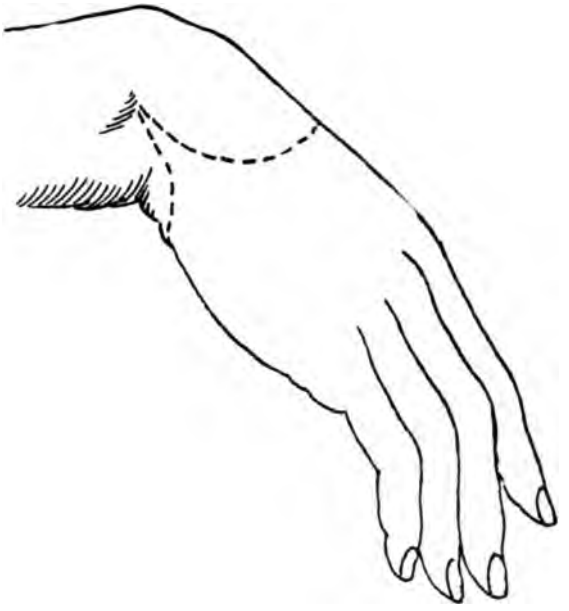


Fig. 478.—Flap method in disarticulation at the wrist.

The dorsal incision is commenced just below the styloid process of the ulna and carried across the wrist in a light slightly concave below, to just beyond the styloid process of the radius. The palmar incision at the same point is carried downwards and outwards, crossing the metacarpal bones of the fingers just below their center and that of the thumb near its base, and ending at the point of termination of the first incision. The dorsal incision is deepened to the joint line, the extensor tendons severed, the posterior and lateral ligaments divided, while the hand is strongly flxed. With the hand still flexed, the palmar flap is cut out from above downwards and outwards and the hand removed. The radial, ulnar and some superficial branches will have to be ligated. The palmar flap is then

brought over the stump and sutured to the dorsum. Instead of the palmar, a dorsal and palmar flap may be secured from the hand.

It is especially to be understood that in amputations about the hand and wrist the surgeon is not bound by any fixed and fast rule. In making his flaps he is at liberty to take them from any part, in order that as much of the limb as possible may be saved (Figs. 477, 478 and 479).

AMPUTATIONS OF THE FOREARM.

In consequence of its shape and the arrangement of the muscles, the forearm, for the purposes of amputation, has been divided into a lower third and an upper two-thirds. In amputations the bones should be sawn, if possible, below the insertion of the pronator radii teres, that the prona-

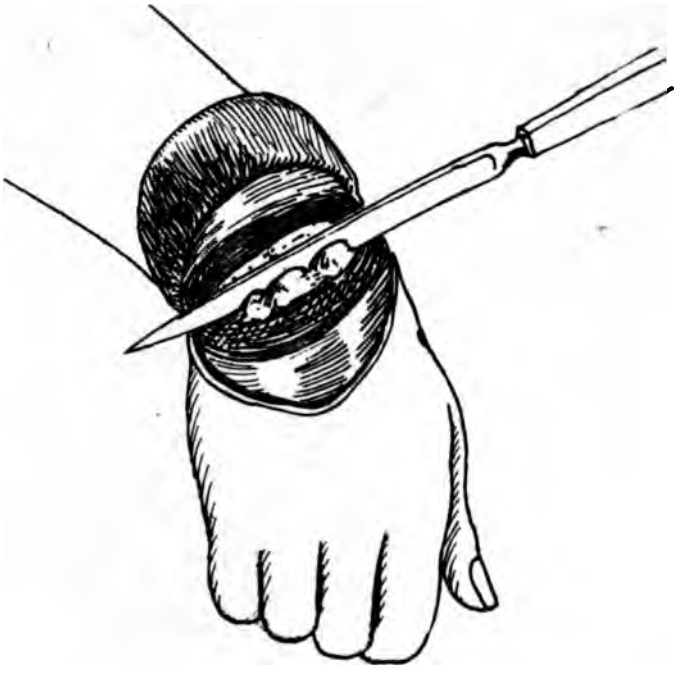


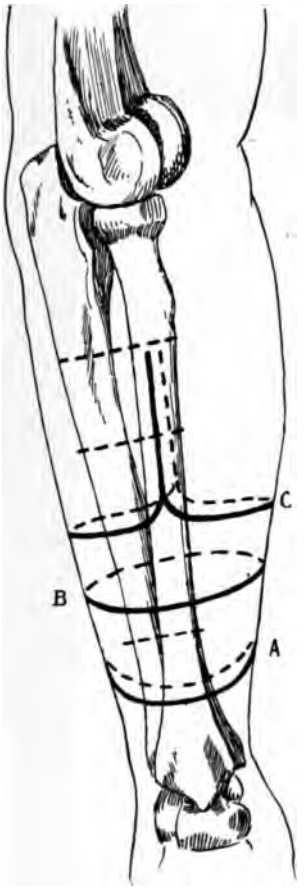
Fig. 479.—Disarticulation at the wrist—flap method.

tion of the stump may be preserved. Amputation through the upper portion of the forearm, with retention of its motions, is preferable to disarticulation at the elbow joint. In amputations, the modified circular or circular cuff method is considered best for the lower third, and the antero-posterior flap for the upper two-thirds.

AMPUTATION THROUGH THE LOWER THIRD. (BILATERAL FLAPS.)

The arm is held well away from the side by an assistant, and in a position midway between pronation and supination (thumb up). The surgeon if reasonably ambidextrous may stand facing the patient, and supporting with his left hand the part to be removed. Each flap at its

-half the circumference and one-half of the diameter
w line.
mmenced in the center of the upper surface, slightly
nd carried directly downwards for one-half an inch
oss the side of the limb to the center line posteriorly,
' upwards to near the sawline. The corners of the
x. The knife is then transferred to the left hand



forearm. A. Bilateral flaps. B. Circular method. C. Antero-posterior flaps.

: out on the other side of the forearm. These flaps
e muscular layers are dissected up for half an inch,
lar incision made with a long knife around the limb
e to the retracted flaps. The bones are then cleared
steal flaps formed, the interosseous tissues divided,
The radial, ulnar and interosseous arteries must be
hould be retrenched. The muscles or tendons should

then be quilted over the ends of the bones, and the flaps united. After the application of proper dressings the forearm is placed in a right-angled splint.

CIRCULAR METHOD. (CUFF VARIETY.)

A circular incision with a long knife is made three-quarters of the diameter of the limb below the sawline. The cuff, including the skin and fascia, is dissected back for one inch and a second circular incision carried through the muscles down to the bones just below the sawline. The periosteal and interosseous membranes are divided at this point and pushed upwards, and the bones sawed; if the cuff cannot be turned back it may be split up on one side. The vessels are ligated, the nerves and tendons cut short, and the flaps sutured.

AMPUTATION THROUGH UPPER TWO-THIRDS OF FOREARM BY EQUAL ANTERIOR AND POSTERIOR FLAPS.

Each flap must equal in length three-quarters of the diameter of the limb at the sawline. Anterior and posterior horseshoe-shaped flaps are made with a scalpel by commencing the incision on the upper aspect of the forearm at the sawline, and carrying it directly downwards the proper distance and then across the arm and up the posterior surface to the sawline. A similar incision is made upon the opposite side of the limb. The lateral incision is deepened to the bone. Flaps consisting of musculo-cutaneous tissue are then dissected up to just below the sawline and the interosseous membrane divided. Periosteal flaps are then formed and the tissues retracted and the bones sawn. After securing the radial, ulnar, anterior and posterior interosseous vessels, the muscles are quilted and the flaps united by interrupted sutures.

DISARTICULATION AT THE ELBOW JOINT.

This is to be preferred to amputation through the arm. Here as elsewhere the method selected will depend upon the condition of the adjacent tissues. Large and well nourished flaps are required to properly cover the lower end of the humerus. Disarticulation may be effected after making an anterior or a posterior elliptical flap, or an anterior or posterior flaps, or the circular cuff method may be adopted. When the tissues are scant and do not predominate on either surface, either the circular method, or the method by equal lateral flaps, will be found most suitable. When the tissues on the anterior surface of the arm will furnish ample flap, the anterior ellipse gives good results.

Technic of the Anterior Ellipse.—The incision is commenced over the prominence of the olecranon, carried down the side of the forearm, and across its anterior surface, making a flap in length equal to one and one-half diameters of the limb at the elbow. It is then carried up the opposite side of the member to the point of starting. The skin and fascia are now retracted and the muscles cut from below upwards and inwards to the joint line. The anterior and lateral ligaments are divided, as well as the tissues on the posterior surface, including the attachments of the triceps. The vessels are ligated, the nerves retrenched, and the muscles of the an-

terior flap quilted, to the muscles and fascia on the upper and posterior surfac of the incision. The skin and fascia of the long anterior flap are then sutured to the upper posterior incision.

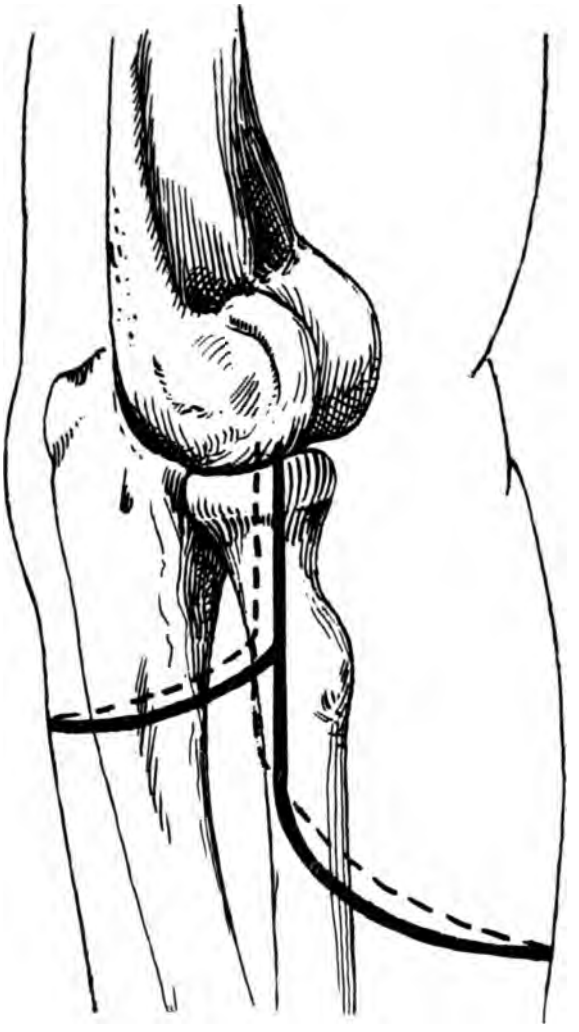


Fig. 481.—Disarticulation at the elbow by long anterior and short posterior flaps.

DISARTICULATION AT THE ELBOW BY LONG ANTERIOR AND SHORT POSTERIOR FLAPS.

The anterior flap should equal in length a little more than one diameter of the limb, and the posterior flap one-half the diameter. An incision is commenced just below the external or internal condyle, carried down the side of the forearm for a sufficient distance, then across its front and then up the opposite side to a point below the condyle. A musculo-cutaneous

flap is dissected up to the joint line. A posterior flap is then made in length equal to one-half of the anterior, and dissected up so as to divide the triceps and relieve the olecranon. The anterior and lateral ligaments are divided and the arm removed. The vessels are secured, including the brachial and muscular branches. The nerves should be shortened and the muscles of the anterior flap quilted to the fascia of the posterior flap. The skin surfaces are then united by interrupted sutures (Fig. 481).

AMPUTATION OF THE ARM.

For purposes of amputation the arm is divided into a lower third and an upper two-thirds. In the lower third, short bilateral flaps, or the modified circular method, is to be preferred. The flaps are usually antero-posterior or they may be lateral. The skin flaps are in length equal to about one-quarter the diameter of the limb. Each flap equals at its base one-half of the circumference of the limb.

In antero-posterior flaps an incision is commenced on the outer or inner side of the limb and carried directly downwards for one-quarter its diameter. Then a rounded corner is made and the incision continued across the limb and up the other side, to a point directly opposite the place of commencement. A similar incision is made upon the opposite side of the arm. These flaps are dissected back to their base. A circular incision is then made through the superficial muscles, which are retracted and then a second circular incision, made through the deeper muscles and about a half inch below the sawline. The periosteum is divided in a circular manner at this point and with the muscles pushed up to the sawline and the bone divided. The vessels, including the brachial, superior and inferior profunda and muscular branches are then secured and the nerves retrenched. The muscles should be quilted over the end of the bone and the skin flaps united by interrupted sutures.

AMPUTATION THROUGH THE UPPER TWO-THIRDS OF THE ARM.

The flap method is to be preferred and in consequence of the greater contraction of the muscles on the anterior and outer surface of the arm, the anterior flap should be the longer. The base of each flap must equal one-half the circumference of the limb. The vessels should be situated in the posterior flap.

An incision is commenced at the sawline and at the inner or outer border of the limb, and carried downwards a distance equal to one diameter of the arm. It is then carried across the front and up the outer side to the sawline. The posterior flap is formed in the same way and equals in length one-half the diameter of the limb at the sawline. The integument is retracted and the muscles divided in a direction upwards and inwards, so as to make the flaps beveled. The bone should be reached sufficiently below the sawline to permit of the formation of a periosteal flap. The periosteum, after being divided in a circular manner, is pushed upwards with the soft tissues and the bone divided. The brachial, superior and inferior profunda arteries will require ligation, as well as some muscular branches. The nerves are retrenched and the muscles quilted over the end of the bone and the skin flaps united by interrupted sutures.

AMPUTATION OF ARM AT SURGICAL NECK.

The surgical neck of the humerus lies between the base of the tuberosities and the insertion of the latissimus dorsi, pectoralis major and teres major.

In amputation at this point a long external and a short internal flap are made when practicable. The external flap is horseshoe-shaped and at

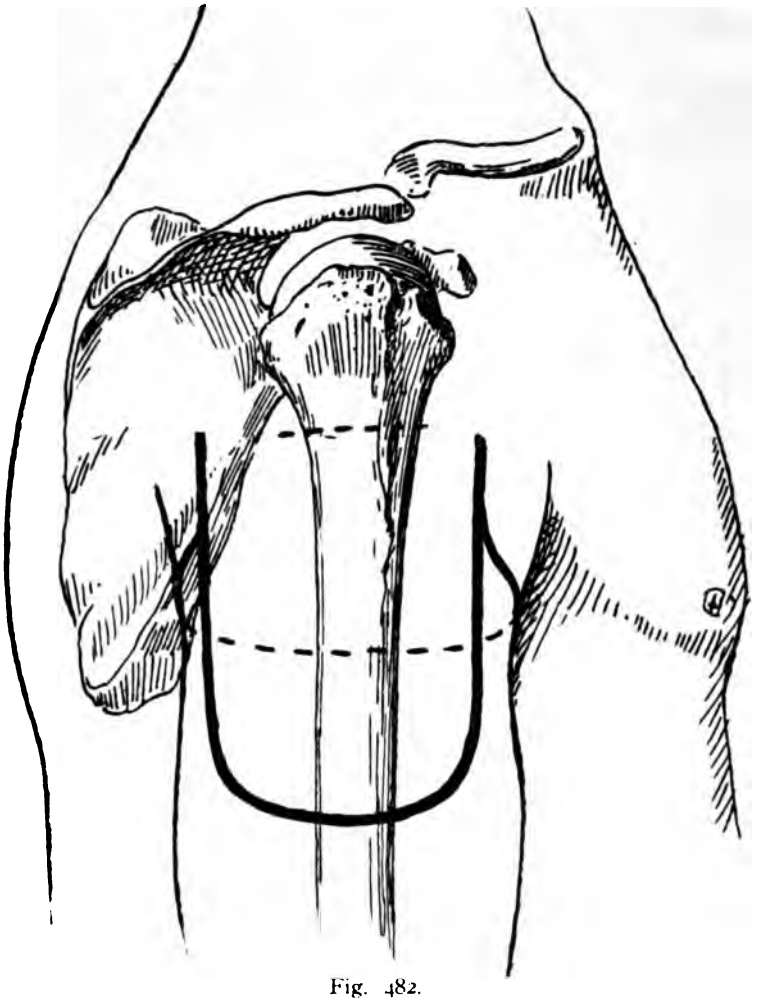


Fig. 482.

its base comprises one-half of the circumference, and in length it should equal one diameter of the limb.

The incision is commenced at the sawline and over the anterior aspect of the arm, and carried downwards for a sufficient distance, and then across the outer surface and up the posterior side to the sawline. The skin and fascia are raised and the muscles cut from without inwards and upwards,

the flap being reflected to near the point where the bone is to be sawn. The vessels are caught as they are divided. The arm is held away from the side and the internal flap marked out. It should be convex below and in length equal to one-half the diameter of the limb. The internal incision is then deepened, and the axillary vessels double ligated before being divided. All of the tissues are raised to the bone at a point one inch below the sawline, when a periosteal flap is formed and the bone sawed. The circumflex nerve and the posterior circumflex artery should be avoided. Branches of the anterior and posterior circumflex artery and some muscular branches will require ligation. The nerves should be cut short. The outer flap is then brought across the end of the bone and its muscles quilted to those in the inner flap. The skin and fascia are united by interrupted sutures.

DISARTICULATION AT THE SHOULDER JOINT.

THE CONTROL OF HEMORRHAGE BY WYETH'S METHOD WITH STEEL PINS.

A pin is made to enter the middle of the anterior axillary fold and emerge to within one inch of the top of the acromion process. The second pin is made to enter the middle of the posterior axillary fold and emerge slightly inside the tip of the acromion process. The ends of the pins are protected by corks. Strong elastic rubber tubing one-half inch in diameter is now wound forcibly several times around the shoulder and axilla and above the pins and then knotted. In the absence of steel pins the rubber tubing may be held in place by crossing the last turns over the top of the shoulder and then carrying the ends about the chest where they are knotted, and by passing strips of bandage around the tubing in front and behind and carrying them around the chest, where they are tied or pulled strongly upon by an assistant. Or, if thought best, and as a first procedure, the axillary vessels may be double ligated and divided, or the third portion of the subclavian artery may be controlled by digital compression.

METHODS. SPENCE'S ANTERIOR RACKET METHOD.

The arm is held well away from the side by an assistant who supports the forearm. An incision is commenced just below and internal to the tip of the acromion process and carried downwards a distance equal to, or a little more than, one diameter of the shoulder. It is then carried downwards and inwards beneath the axillary fold and directly around the arm posteriorly to the outer border, when it curves upwards and inwards to join with the perpendicular incision. The skin and fascia are first dissected up for about an inch, the perpendicular incision is deepened to the bone, and the muscular tissues on the outer and posterior portion of the limb divided in a direction upwards and inwards. Near the shoulder joint the knife should be kept close to the bone to avoid injury to the circumflex nerve and posterior circumflex artery. By rotating the arm, the muscular attachments to the tuberosities can be reached and should be divided close to the bone. The long head of the biceps is then cut and the joint freely opened in front and the head of the bone pushed out of its socket, and away from the side. An assistant can, if necessary, now control the vessels on the internal sur-

face, while these are divided from within outwards. The brachial artery and the *venae comites* are then ligated, as well as some branches of the acromial thoracic and anterior circumflex. The nerves are retrenched and the muscles brought together by buried sutures. The skin and fascia are united by interrupted sutures. Drainage is usually necessary for a few days (Fig. 483a).

LARREY'S OPERATION BY EXTERNAL RACKET METHOD.

This operation does not differ materially from Spence's, except that the perpendicular incision is placed farther outwards and commences over the most prominent portion of the acromion process. From this point it is

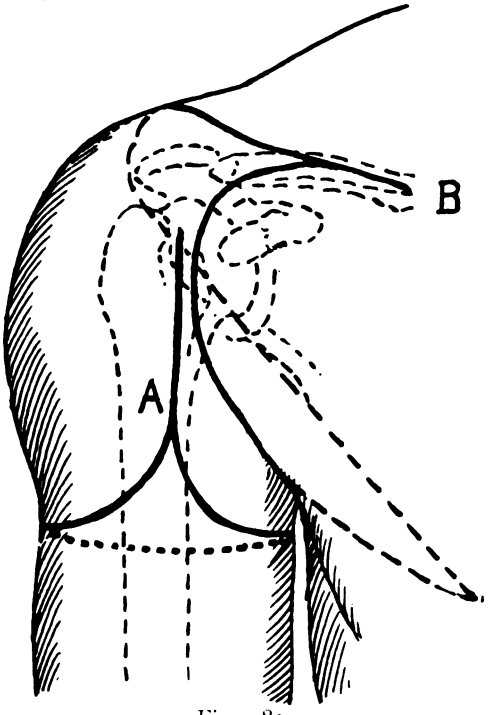


Fig. 483.

carried downwards four inches and goes to the bone. From the center of this incision two incisions are carried downwards and across the lateral aspects of the limb to meet on its posterior border and on a level with the extremity of the perpendicular incision. The lateral incision goes through the skin and fascia. The arm is then rotated outwards and the structures between the perpendicular incision and the vessels divided, including the internal part of the deltoid, the tendon of the pectoralis major, the coraco-brachialis and the biceps.

The vessels are then exposed, double ligated and divided. The flap is freed up to the joint. The arm is then rotated inwards and the incision on the outside of the arm carried through the muscles to the bone and up-

wards to the joint. While the limb is rotated outwards and inwards the muscular attachments to the tuberosities are severed close to the bone. The joint is now opened in front by a transverse incision over the head, which is thrust through the wound. The bone is seized and dragged outwards and the remaining soft tissues on the posterior and internal surfaces divided. Any vessels which bleed are ligated, and the nerves retrenched. The muscles are quilted with catgut and the skin flaps united with silkworm gut. Drainage should be provided for a few days.

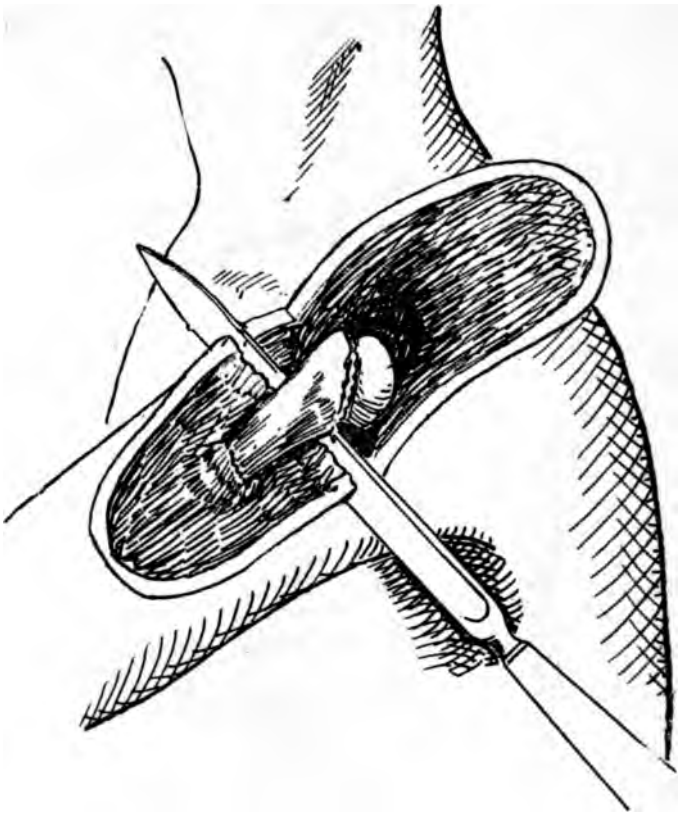


Fig. 484.—Lateral flap method of disarticulating the shoulder.

Disarticulation of the shoulder by the external or deltoid flap is seldom practised at the present time.

AMPUTATION OF THE UPPER LIMB TOGETHER WITH THE SCAPULA AND PART OF THE CLAVICLE.

This operation may be required for the removal of malignant growths attached to the scapula and clavicle and implicating the soft structures about the joint.

The first part of the operation is carried out for the purpose of controlling the circulation. When practicable, the middle, or middle and outer

thirds of the clavicle are resected as the first step. An incision is made over the middle third of the clavicle and down to the bone, the periosteum separated and the clavicle divided through its internal third with a chain saw or bone forceps. The inner end of the outer portion is then seized with bone forceps, lifted upwards and separated from its periosteum and divided through the outer third, or disarticulated. The periosteum and subclavius muscle are then divided and retracted, and the subclavian artery exposed, double ligated and divided. At the same time if the transversalis colli and supra-scapular arteries can be secured, the circulation through the part to be removed will be under control. The subclavian vein may also be double ligated and divided if accessible through the same wound, or its ligation may be deferred until it is exposed or divided during the amputation.

FORMATION OF PECTORO-AXILLARY FLAP.

An incision is commenced at the middle of the clavicle and carried downwards and outwards over the head of the humerus, then downwards and inwards across the anterior axillary fold; then across the axilla, and terminates near the anterior angle of the scapula. The incision at first goes through skin and fascia. It is then deepened, the muscles divided, and the limb freed anteriorly (Figs. 483b and 484).

FORMATION OF POSTERO-SUPERIOR FLAP.

The arm is carried across the chest and an incision, commencing at the external end of the clavicular incision, is carried downwards over the spine of the scapula and to the end of the anterior incision by the most direct route. The incision first goes through the skin and fascia, the flap is retracted, the trapezius exposed, and its attachments to the clavicle divided. The limb is now pulled away from the side and the muscles connecting the scapula and chest wall divided. These are the omohyoid, the levator anguli scapulæ, the rhomboid and the serratus magnus. The extremity is now freed and removed. During the excision some small arterial branches may require ligation or control by forceps pressure. The nerves should be cut short and the flaps sutured. Drainage will be required for a few days.

AMPUTATION OF THE TOES. GENERAL CONSIDERATIONS.

Excepting the big toe, amputation or disarticulation through the phalanges is not advisable, disarticulation at the metatarso-phalangeal joint being preferable. The heads of the metatarsal bones should be preserved when practicable, as their presence gives greater strength to the foot, and the cicatrix should be on or near the dorsum or terminal, so as to be free from the effects of pressure. The flaps may be antero-posterior or lateral and are cut from without inwards. It is not necessary to stitch the divided tendons to the flaps, but the tendon sheaths should be closed by suture. In disarticulation, the dorsal structures are divided during forced flexion and the palmar during strong extension. In cutting the flaps the incision goes to the bones. In freeing the soft tissues, the knife should hug the bone so as to preserve the digital arteries from injury. As a rule the divided vessels do not require ligation. The flaps are approximated by one or two sutures. Drainage is not necessary.

OPERATION THROUGH THE FIRST PHALANGES. OVAL OR RACKET METHOD.

The incision commences just below the metatarso-phalangeal joint the middle of the dorsal region and goes directly downwards for about on quarter of an inch. It then branches and is carried over each side of t

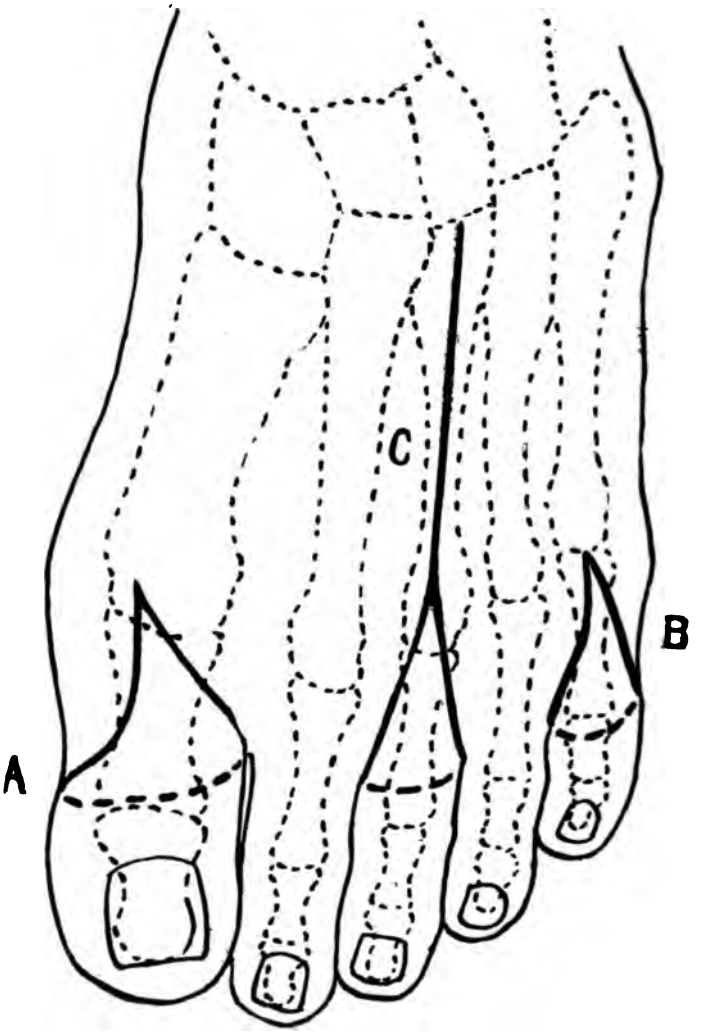


Fig. 485.—Disarticulation of the toes. A. Farabeuf's method. C. Removal of a t with its metatarsal bone.

toe at the borders of the web so as to make flaps convex below, and th transversely across the sole. The incisions are deepened to the bone, t soft tissues separated to the sawline, and the bone divided. The flaps a sutured perpendicularly.

DISARTICULATION OF THE SECOND, THIRD, OR FOURTH TOES AT THE METATARSO-PHALANGEAL JOINT. OVAL METHOD.

The incision is commenced one-half an inch above the articulation, in the middle of the dorsal region, and goes directly downwards for about one inch; it then branches and is carried across each side of the toe and through the borders of the web, so as to make a convex flap below, then transversely across the sole. The incisions are deepened to the bone, and in separating the soft tissues the knife is made to hug the bone up to the articulation. The toe is now forcibly flexed and the tendons and ligaments on the dorsal surface divided and then extended, and those on the plantar

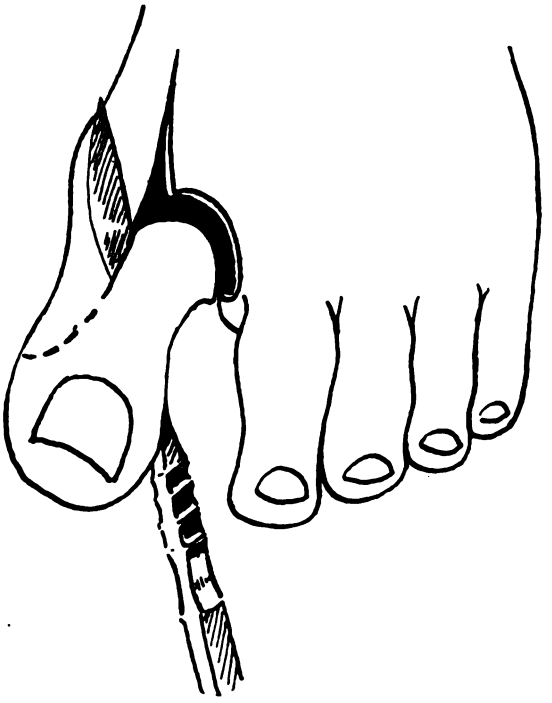


Fig. 486.—Disarticulation of great toe at the metatarso-phalangeal joint. Internal flap.

surface divided, and the toe removed. The flexor sheaths should be closed. The flaps are sutured perpendicularly.

DISARTICULATION OF GREAT TOE AT METATARSO-PHALANGEAL JOINT BY AN INTERNAL PLANTAR FLAP. (FARABEUF.)

This is a modification of the oval method. The incision is commenced on the dorsum just behind the articulation and at the junction of the dorsal and internal surfaces, and is continued directly downwards as far as the neck of the first phalanx. It is then carried across the internal surface of the toe, reaching the posterior aspect near the head of the bone. The incision is then continued across the plantar surface in a direction upwards

and outwards, so as to reach the external surface at the interdigital web. It is then carried across the external and dorsal surface in a direction upwards and inwards to reach the point of starting. The incisions are deepened, and the knife kept close to the bone up to the joint, when the toe is removed. After securing the vessels the long internal plantar flap is sutured to the short external or dorsal flap. This places the cicatrix on the superior and external surface away from the pressure of the shoe.

The incisions may be modified as shown in Fig. 485a.

DISARTICULATION OF THE LITTLE TOE AT THE METATARSO-PHALANGEAL JOINT BY AN EXTERNAL PLANTAR FLAP.

An incision is commenced at the anterior border of the metatarso-phalangeal joint, carried downwards and inwards to the interdigital web,

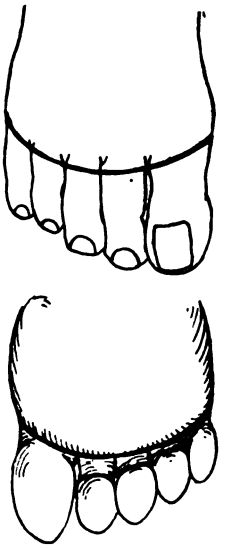


Fig. 487.—Removal of all the toes at the metatarso-phalangeal joints.

then outwards across the plantar surface. On reaching the outer border of the toe it is carried upwards and inwards to the point of starting. The incisions are deepened, the knife being kept close to the bone and the toe disarticulated. The external plantar flap is then stitched to the line of the internal dorsal incision.

DISARTICULATION OF ALL THE TOES AT THE METATARSO-PHALANGEAL JOINTS BY EQUAL DORSAL AND PLANTAR FLAPS.

An incision is commenced in the center of the lateral aspect of the metatarso-phalangeal joint of the great or little toe and carried directly downwards to near the base of the first phalanx. It is then carried across the dorsum of each toe, dipping down between the toes at the borders of the web. On crossing the last toe it is carried up the outer or inner side of the metatarso-phalangeal joint. A similar incision is made on the plantar

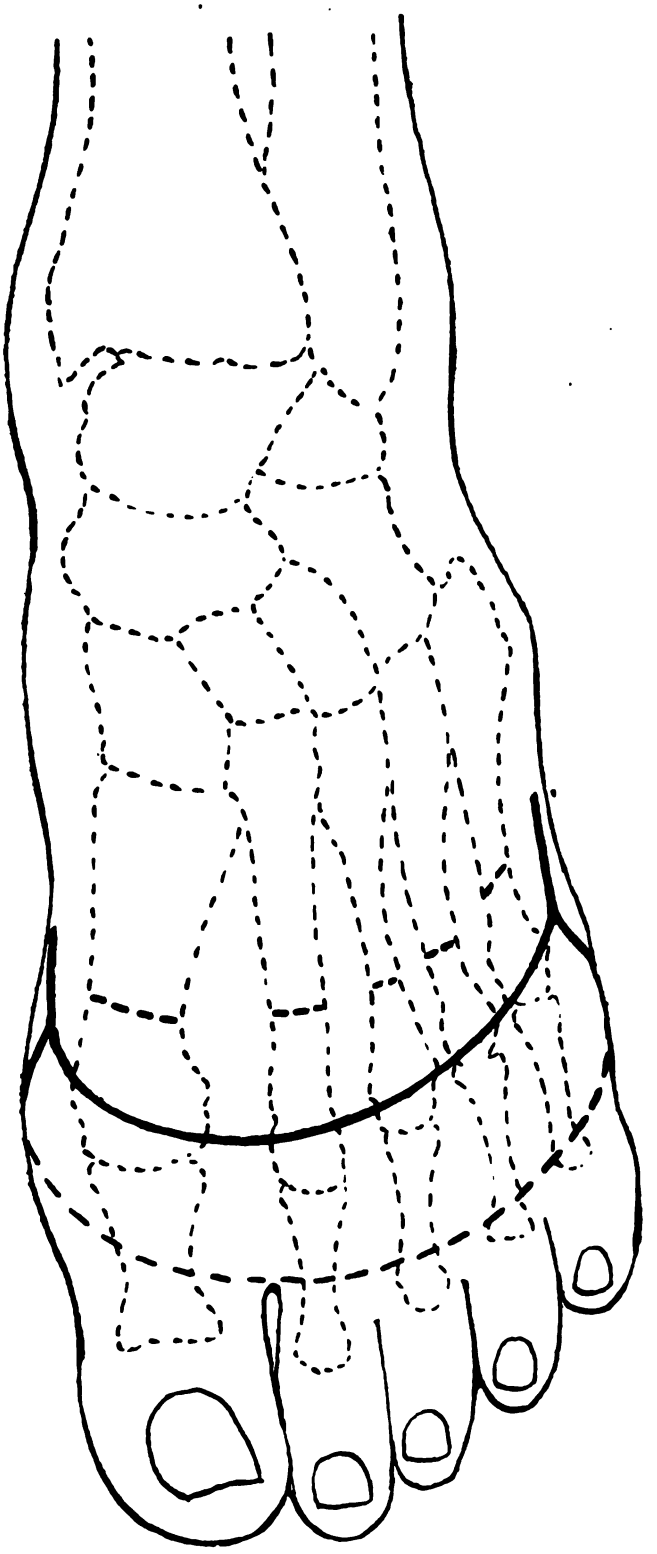


Fig. 488.—Amputation through the metatarsal bones by long plantar and s

[illegible] connecting the two lateral perpendicular incisions. The flaps are dissected up and the toes disarticulated. The flexor sheaths are closed and the flaps united in a transverse line.

GENERAL CONSIDERATIONS IN AMPUTATIONS ABOUT THE FOOT.

Preserve as much as possible of the metatarsal bones of the great and little toes, as they strengthen the foot and give support to the body.

The cicatrix should be terminal or dorsal. The plantar flap is the best. Amputation through the metatarsus is to be preferred to tarso-metatarsal disarticulation, as in the former the attachments of important muscles are preserved.

Disarticulation at the tarso-metatarsal joints (Lisfranc's operation) gives a satisfactory stump.

Disarticulation at the medio-tarsal joint, that is between the astragalus and scaphoid and the os calcis and cuboid, gives a stump less satisfactory (Chopart's operation).

Subastragaloid disarticulation gives a good stump. The modified amputation at the ankle, in which the os calcis is sawn posterior to the astragalus, the articulating surfaces of the tibia and fibula removed, and the former applied to the latter, gives a wound which heals slowly and a result which is not always satisfactory. (Pirogoff's operation.)

Amputation at the ankle joint (Syme's operation) is usually to be preferred to either Chopart's or Pirogoff's amputation.

AMPUTATION THROUGH THE METATARSAL BONES BY LONG PLANTAR AND SHORT DORSAL FLAPS.

The incision is commenced over the outside of a metatarsal bone, slightly behind the sawline and carried directly downwards for a distance equal to the perpendicular diameter of the foot at the base of the flap. It is then carried across the sole and up the opposite side of the foot slightly above the sawline. A dorsal incision, convex below, is then made uniting the two lateral incisions and forming a flap equal to one-half the length of the plantar flap. The flaps are then dissected up, the extensor and flexor tendons divided, the bones cleared of soft tissue and divided. The digital arteries, on the plantar surface, and the interossei on the dorsal, will require ligation. The muscles are then quilted and the skin flaps united by interrupted sutures.

DISARTICULATION OF A TOE WITH ITS METATARSAL BONE. (RACKET METHOD.)

The incision begins on the dorsal surface just above the tarso-metatarsal joint and is carried directly downwards to the head of the metatarsal bone. From this point it branches and is carried over the sides of the toe, making flaps convex below; it is then carried transversely across the plantar surface. The lateral incisions cross the interdigital web. The perpendicular and oval incisions are deepened, the tendons divided and the soft tissue separated from the metatarsal bone with a periosteal elevator, back to the tarso-metatarsal joint. The joint is opened on its dorsal surface during

strong extension of the foot, and the bone and toe removed. The vessels are ligated and the flaps sutured in a straight line.

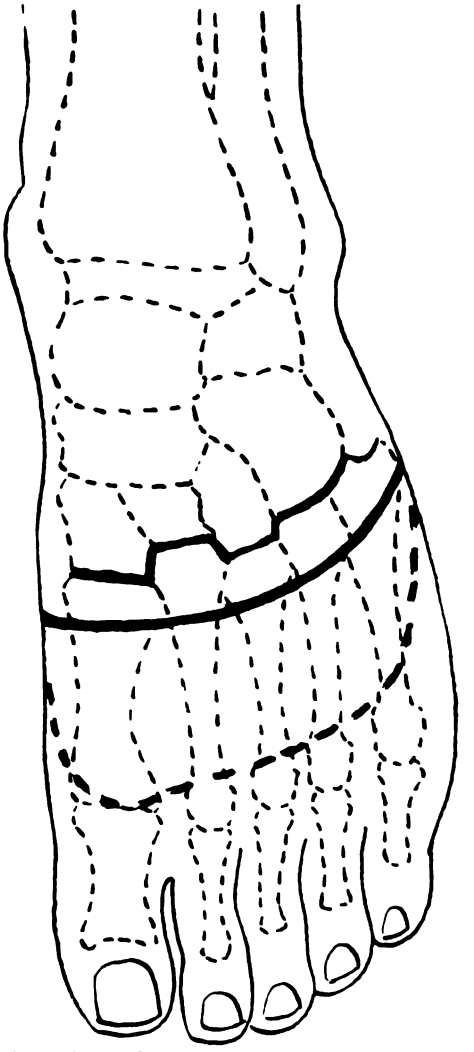


Fig. 489.—Disarticulation of the foot at the tarso-metatarsal joints by short dorsal and long plantar flaps. Lisfranc's operation.

DISARTICULATION OF THE FOOT AT THE TARSO-METATARSAL ARTICULATION BY SHORT DORSAL AND LONG PLANTAR FLAPS. (LISFRANCS' AND HEY'S METHOD.)

The surgeon grasps the foot with his left hand and commences the incision on the outer side of the foot and just above the fifth metatarsal bone. From this point it is carried downwards for one inch and then across

the dorsum, making a flap convex below and slightly longer towards the internal aspect. The incision is then carried upwards on the internal surface to a point just above the base of the metatarsal bone. The plantar incision commences and ends at the same points as the dorsal, and is carried down the side of the foot for two inches, then across the sole, making

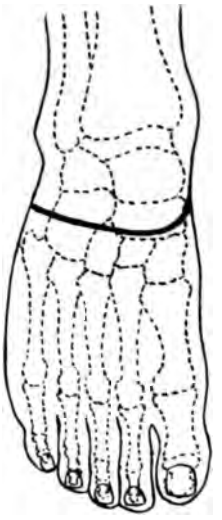


Fig. 490.—Disarticulation of the medio-tarsal joints. Chopart's operation.

a convex flap below, and one longer on its internal aspect than on its outer, and up the opposite side, uniting with the limb of the anterior incision. The flexor tendons are divided and the dorsal flap raised to slightly beyond the tarso-metatarsal joint. The plantar flap is dissected up to the tarso-metatarsal joint, taking all of the tissues to the bones. Disarticulation is now

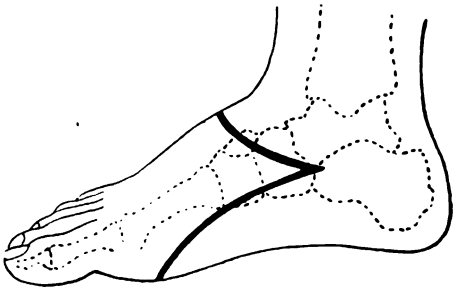


Fig. 491.—Flaps in Chopart's operation. Inner side of foot.

effected by entering the knife just behind the base of the fifth metatarsal bone and cutting downwards and inwards, dividing the attachments of the fifth, fourth and third bones to the tarsus. The first metatarsal bone is now disarticulated, its joint being situated one-fourth of an inch anterior to the joint of the third metatarsal bone. The base of the second meta-

tarsal may now be sawed across (Hay's method), or the knife inserted between the base of the second metatarsal bone and the internal cuneiform and the attachments divided. The ligamentous attachments binding the base to the middle cuneiform are then divided, while the metatarsus is in a position of strong extension. The foot is then removed. The dorsal interossei, the plantar digital and the communicating branch of the dorsal pedis will require ligation. The muscles are then quilted and the integument sutured.

DISARTICULATION AT THE MEDIOTARSAL JOINT BY LONG PLANTAR AND SHORT DORSAL FLAPS. (CHOPART'S OPERATION.)

The astragalo-scaphoid joint lies just behind the tuberosity of the scaphoid. The calcaneo-cuboid articulation is midway between the external malleolus and the base of the fifth metatarsal bone.

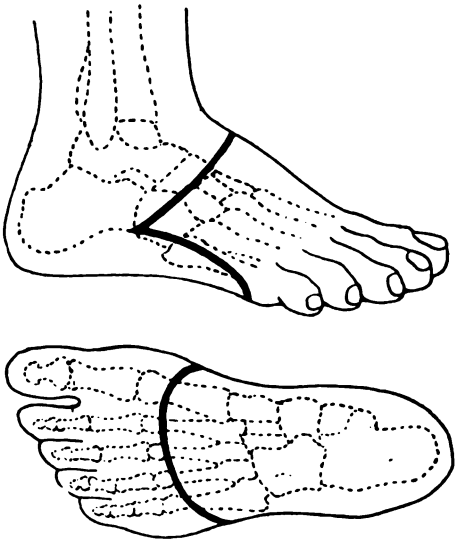


Fig. 492.—Chopart's operation. Lines of incision on outside and sole of foot.

An incision is commenced on the outer side of the foot and over the mediotarsal articulation and carried directly downwards for about two inches. It is then continued across the plantar surface so as to cut a flap convex below and longer on its internal than on its external surface. On reaching the internal border of the foot the incision is carried directly upwards to the mediotarsal articulation. The dorsal incision commences on the outer side of the foot at the same point as the plantar and passes downwards and inwards across the bases of the metatarsal bones, making a flap convex below and longest on its inner side. On reaching the internal border of the foot the incision is carried directly upwards along the line of the plantar incision. The plantar flap is now dissected up to the mediotarsal joint, carrying all of the tissues to the bone. The dorsal flap is dissected up to the same point. The foot is disarticulated from the dorsum while

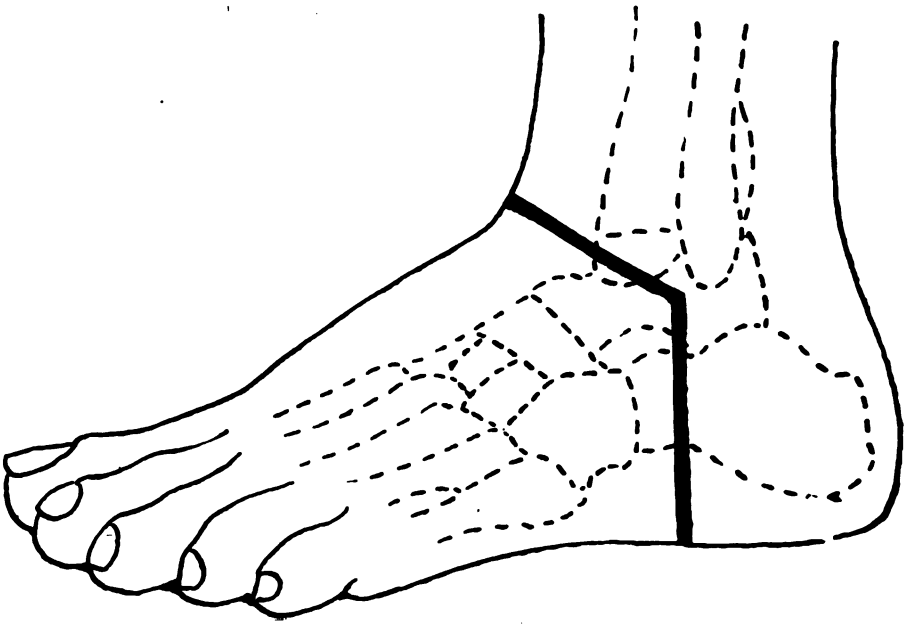


Fig. 493.—Lines of incision in Syme's operation. Outside of foot.

carrying it strongly outwards and in extension and from the plantar surface by carrying it upwards—the tendo Achilles may be divided. The anterior tibial, external and internal plantar vessels will require ligation. The heel flap is then brought upwards and attached to the dorsal flap. Drainage should be established directly through the heel (Figs. 491 and 492).

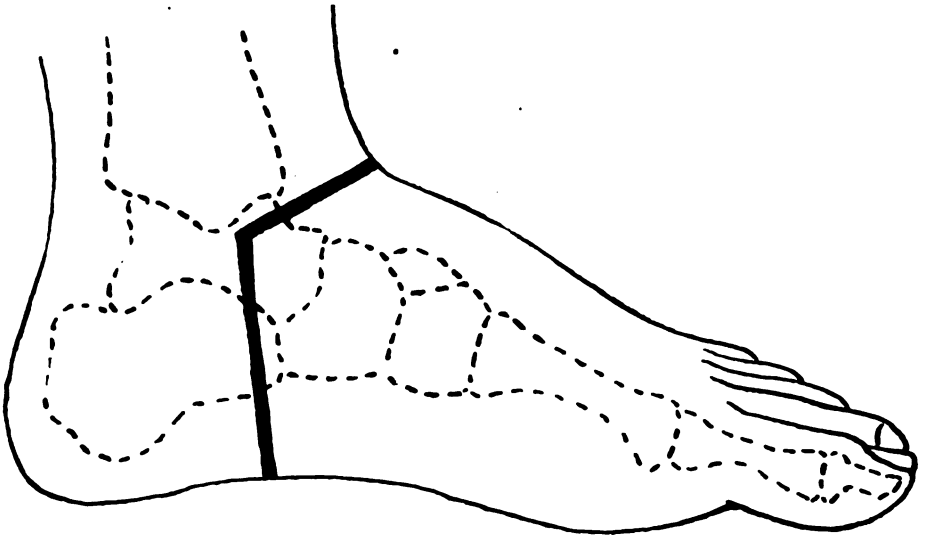


Fig. 494.—Lines of incision in Syme's operation. Inside of foot.

SYME'S OPERATION.

This is a disarticulation at the ankle joint with the removal of the malleoli and articular surface of the tibia.

The foot should be at right angles with the leg. The plantar incision begins at the tip of the external malleolus and is carried to the bone and squarely across the sole and up the inside of the foot to within one-half inch of the internal malleolus. A second incision is made across the instep connecting the two ends of the dorsal incision. The ankle joint is opened from the front and the lateral ligaments divided. The os calcis is now dissected out by cutting from above downwards and also by dissecting the heel flap from below upwards. Care should be taken to keep the knife close to the

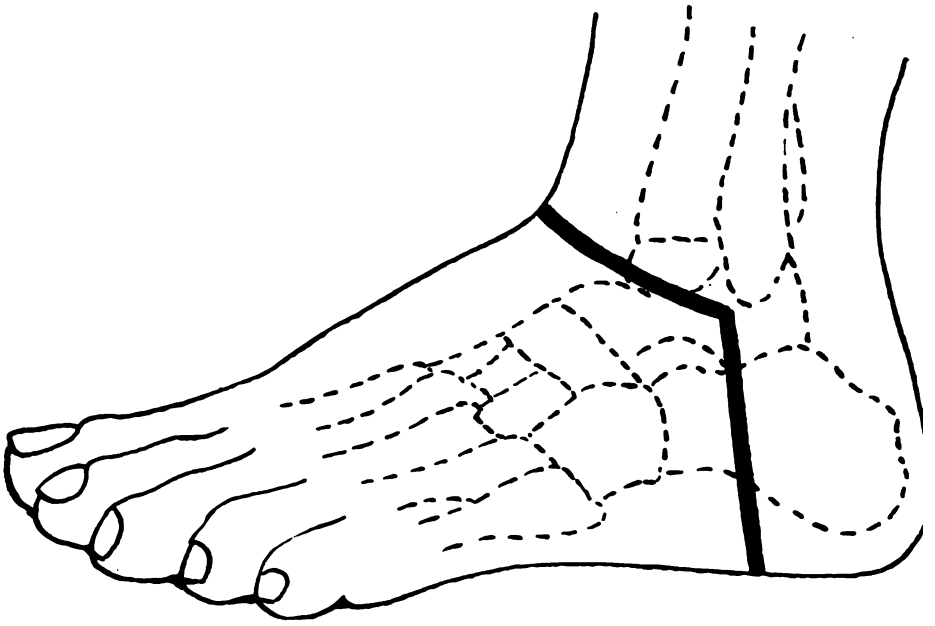


Fig. 495.—Lines of incision in Pirogoff's operation. Outside of foot.

bone and not button-hole the flap. The malleoli and articulating surface of the tibia are removed with a saw. The anterior tibial artery will require ligation in the dorsal flap, and the terminations of the internal and external plantar arteries in the plantar flap. The muscles of the two flaps are then quilted and united by interrupted sutures. The heel flap should be drained (Figs. 493 and 494).

DISARTICULATION OF THE FOOT AT ANKLE JOINT. (PIROGOFF'S OPERATION.

In this operation the malleoli and the articulating surface of the tibia are removed, and the anterior portion of the os calcis sawed, the remaining portion being adjusted to the sawed surface of the tibia.

The plantar incision begins just anterior to the tip of the external malleolus, is carried directly downwards and across the sole and up the internal surface of the foot to within one-half inch of the anterior extremity of the internal malleolus. The dorsal incision, convex below, is carried across the ankle to the extremities of the plantar incision. The plantar heel flap is dissected back for one inch, the dorsal flap dissected up and the joint opened in front. The lateral and posterior ligaments are divided and the foot pulled downwards and forwards. The os calcis is then sawed behind the astragalus in a direction downwards and slightly forwards. The lower end of the tibia and fibula are then freed and the bones sawed just above the articulating surface of the tibia. The tibia should be sawed from before backwards and slightly upwards. The same vessels require ligation as in the previous operation. The heel flap is then brought forwards and the

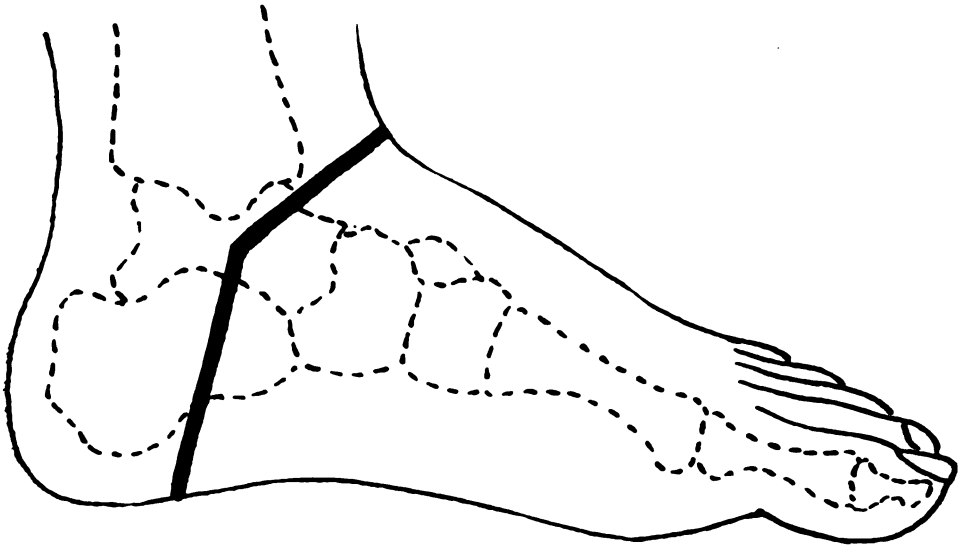


Fig. 496.—Lines of incision in Pirogoff's operation. Inside of foot.

fibrous tissue surrounding the ends of the bone first sutured, and then the flaps. The stump is longer and is perhaps better nourished than in Syme's operation, but the os calcis may fail to unite, may be dragged backwards by the tendo Achilles, or become necrosed. The operation is much more difficult than Syme's, and more likely to be followed by complications (Figs. 495 and 496).

AMPUTATION OF THE LEG THROUGH THE SUPRA-MALLEOLAR REGION BY OBLIQUE ELLIPTICAL INCISIONS.

An incision is commenced just in front of the ankle and carried downwards and backwards below the internal malleolus to the summit of the heel. A similar incision is made on the outside commencing and ending at the same point and passing just below the external malleolus. The incisions are deepened to the bones and the flaps dissected up to a point about two

inches above the tips of the malleoli, care being taken to preserve the posterior tibial vessels. The peroneal tendons are divided at the base of the flap, a periosteal covering for the tibia is formed, the tissues reflected and the bones sawed. In amputation of the leg the fibula should be divided from one-half to one inch higher than the tibia. The anterior and posterior tibial arteries and some muscular branches will require ligation. The nerves are drawn down and cut short. The posterior heel flap is then sutured to the anterior concave incision. Drainage is usually necessary through the most dependent portion of the heel flap (Fig. 497).

AMPUTATION THROUGH THE LOWER THIRD OF THE LEG.

The muscles being situated largely on the posterior and internal surfaces, a long posterior and short anterior flap are considered most suit-

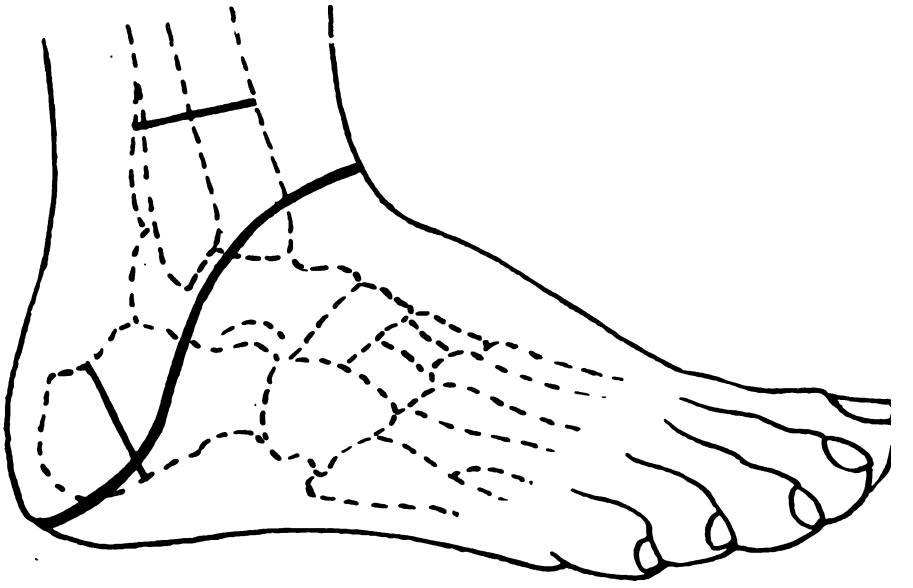


Fig. 497.—Amputation of the leg through the supra-malleolar region.

able. The posterior flap may be made by transfixion with a long knife, cutting from within outwards or by cutting from without inwards with a large scalpel. In the latter method an incision is commenced at the sawline and over the posterior border of the tibia, and carried directly downwards for one and one-quarter diameters of the limb. It is then carried across the posterior surface and up the other side of the limb, just behind the fibula and to a point directly opposite the place of commencement. The flap is retracted and the muscles divided in a direction upwards and inwards to just below the base of the flap. An incision is now made across the front of the leg, connecting the extremities of the original incision and marking out a flap convex below and equal in length to one-quarter the diameter of the limb. This flap is dissected up to near its base, the interosseous membrane divided and periosteal flaps formed for the tibia and fibula and the

bones sawn. The anterior and posterior tibial and peroneal arteries will require ligation. The nerves are retrenched. The posterior muscular flap is sutured over the end of the bones and the skin flaps united. The limb should be supported on a splint and the stump kept out from under the bed clothes (Fig. 498).

AMPUTATION THROUGH THE MIDDLE THIRD OF THE LEG BY A LONG POSTERIOR AND SHORT ANTERIOR FLAP.

The technic of this operation is practically a repetition of that already given.

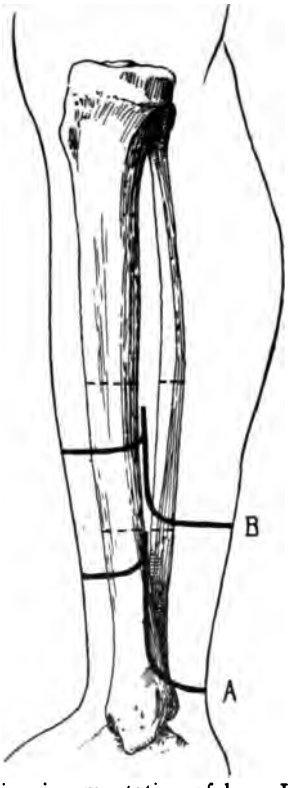
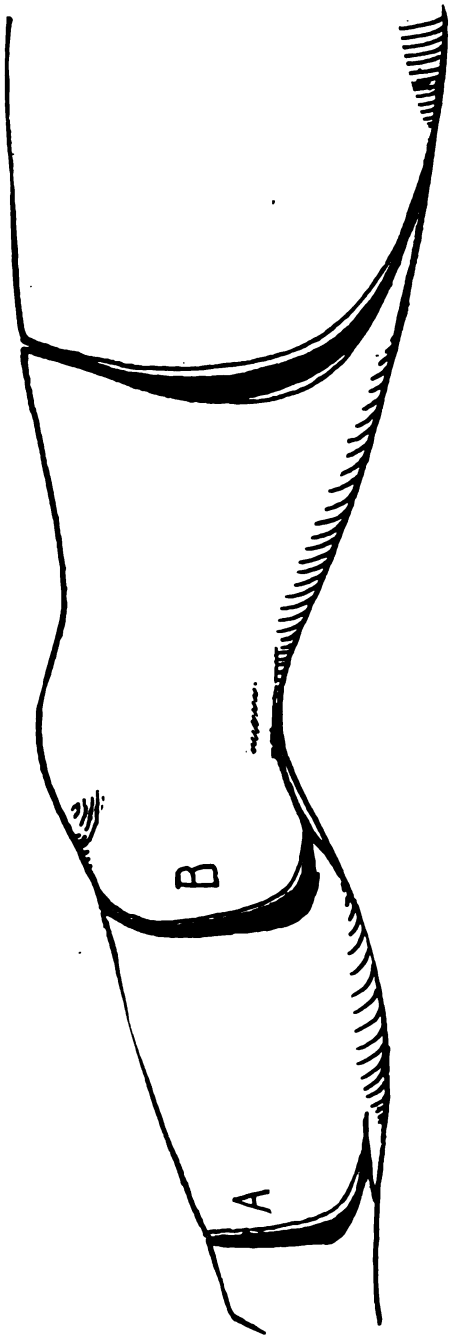


Fig. 498.—Lines of incision in amputation of leg. Lower and middle third.

AMPUTATION THROUGH THE UPPER THIRD OF THE LEG BY BILATERAL FLAPS.

(STEPHEN SMITH'S METHOD.) (FIG. 499.)

An incision is commenced over the crest of the tibia and at a point below the sawline equal to one-half the diameter of the limb, and carried downwards for one inch, then across the side of the limb, making a flap slightly convex below. When the incision reaches the posterior surface of the leg it is carried inwards and upwards to the center and then con-



g. 499.—Stephen Smith's method of making

tinued to the sawline. The flap at its base should equal one-half the circumference of the limb. A similar incision is then made upon the opposite side and the flaps consisting of skin and fascia dissected up for about one inch. A circular incision is then made about the limb and to the bones. The soft tissues are retracted to within one inch of the sawline, the interosseus membrane divided, periosteal flaps reflected and the bones sawed. The anterior and posterior tibial and perineal arteries require ligation. The nerves are retrenched and the muscles quilted over the ends of the bones and the skin flaps united perpendicularly.

DISARTICULATION AT THE KNEE JOINT.

METHOD OF STEPHEN SMITH. BILATERAL FLAPS.

This is to be preferred to amputation through the thigh.

An incision is commenced one inch below the tuberosity of the tibia, carried directly downwards for one inch, and then across the lateral surface of the limb so as to make a flap slightly convex below. On reaching the posterior surface of the limb, the incision is carried upwards and inwards to the center and to the joint line. A similar incision is made upon the opposite side of the limb. These flaps, consisting of skin and fascia, are dissected up to the joint. The ligamentum patellæ is incised, the leg flexed, and all the structures on the anterior and lateral surfaces of the joint divided. This will include the tendons of the biceps, the sartorius, gracilis, the semitendinosus and the lateral and coronary ligaments. The knee joint is now freely opened, the crucial ligaments, and the structures upon the posterior surface of the leg divided, and the limb removed.

Neither the patella nor the semilunar cartilages are removed. The popliteal artery and some muscular branches will require ligation. The nerves are cut short and the flaps united by interrupted sutures. Drainage should be established for a few days.

GENERAL CONSIDERATIONS IN AMPUTATIONS THROUGH THE THIGH.

In the young, division of the bone below the lower epiphyseal line is desirable in order to preserve the growth of the limb.

In grown people amputation is usually done through the lower third.

Subtrochanteric amputation is preferable to a disarticulation.

The greatest amount of retraction occurs in the muscles situated at the posterior and internal surfaces, and the lower the division of the muscles the greater the retraction.

In operations through the lower and middle thirds hemorrhage is controlled by constricting the upper part of the thigh with a piece of rubber tubing.

In disarticulation at the hip joint hemorrhage is controlled by Wyeth's or some similar method.

When rapidity of operation is important, the flaps may be formed by transfixion, cutting from within outwards, or the circular method may be adopted. The stump should be snugly bandaged up to the hip, the last turns of the bandage going around the body so as to prevent the dressing from slipping off. The stump should be supported on a posterior splint.

In amputations through the lower third in muscular individuals where retraction is excessive and threatens to produce undue pressure of the bone upon the flaps, and the formation of a conical stump, strips of adhesive plaster may be applied to the sides of the stump from which extension is made.

METHODS OF AMPUTATION THROUGH THE THIGH.

(1) AMPUTATION THROUGH THE CONDYLES BY ANTERO-POSTERIOR FLAPS.

(2) BILATERAL FLAPS ACCORDING TO THE METHOD OF STEPHEN SMITH.

(3) LONG ANTERIOR AND SHORT POSTERIOR FLAPS.

AMPUTATION THROUGH THE CONDYLES BY ANTERO-POSTERIOR FLAPS.

MODIFIED GARDEN'S METHOD. OPERATION ON THE RIGHT LEG.

ANTERO-POSTERIOR FLAPS.

An incision is commenced over the center of the external condyle and carried downwards and forwards so as to cross the ligamentum patellæ; it is then carried inwards and upwards to the center of the internal condyle. The incision should include the skin and fascia. The posterior incision commences and ends at the same points as the anterior, and forms a flap upon the posterior surface of the limb convex below and one-third longer than the anterior flap. The anterior flap is dissected up, carrying the skin and deep fascia to just above the patella, where the quadriceps extensor is divided. The posterior flap is then dissected up, the hamstring tendons divided and the end of the femur cleared. The bone is sawed through the condyles. The popliteal artery and its muscular branches will require ligation. The nerves are retrenched, the soft tissues sutured over the ends of to the bone. A periosteal flap is then formed, the tissues retracted to the posterior splint.

AMPUTATION THROUGH THE LOWER THIRD BY BILATERAL FLAPS. STEPHEN SMITH'S METHOD.

Each flap should equal at its base one-half of the circumference of the limb (Fig. 500).

An incision is commenced in the center of the anterior surface and one-half diameter below the sawline, and carried downwards for one inch, and then across the side of the limb, making the flap slightly convex below. On reaching the posterior surface the incision is carried upwards to the median line and then to the sawline. This incision goes down to the muscles. A similar incision is made on the opposite side and these flaps retracted and reflected upwards for one inch. A circular incision is then made about the limb and through the superficial layer of muscles. These tissues are retracted to near the sawline, when a circular incision is made to the bone. A periosteal flap is then formed, the tissues retracted to the sawline and the bone divided. The vessels are now secured, the main vessels

being the femoral with its muscular branches. The nerves are retrenched, the muscles quilted over the end of the bone and the skin flaps united.

A circular method of amputation is often practised through the lower third of the thigh, when the tissues on each aspect of the limb are about equally preserved. As a rule the least amount of tissue is sacrificed by the circular method.

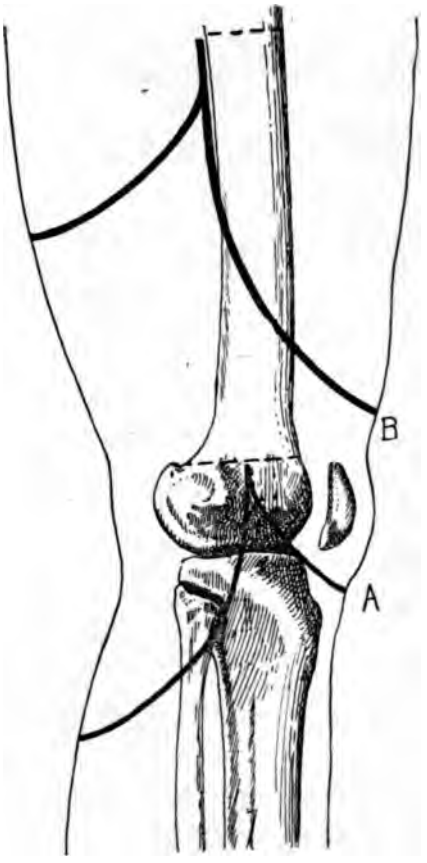


Fig. 500.—A. Disarticulation at knee by short anterior and long posterior flaps. B. Amputation through lower third of thigh by long anterior and short posterior flaps.

AMPUTATION THROUGH THE MIDDLE OR UPPER PART OF THE THIGH BY LONG ANTERIOR AND SHORT POSTERIOR FLAPS.

Two horseshoe-shaped flaps are marked out, consisting of skin and fascia, each flap equaling at its base one-half the circumference of the limb, while the anterior equals in length one and one-half and the posterior one-half, diameters of the limb at the sawline.

Amputation Through the Right Thigh.—An incision is commenced at the sawline, at the middle of the internal aspect, and carried directly down-

wards for nearly one and one-half diameters of the thigh. It is then continued across the anterior surface, making a flap convex below, and up the other side of the limb to the sawline. The muscular tissue on the anterior surface is now picked up and divided from without inwards and upwards to just below the base of the flap. The posterior flap convex below is now marked out and should equal in length about one-half the diameter of the limb, the incision commencing and terminating at the same point as for the anterior flap. The muscles of the posterior flap are divided from without, inwards and upwards. The flaps are retracted and the knife swept about the bone, one inch below the sawline, dividing the periosteum, which is pushed upwards and the bone sawed. Above the middle of the femur the femoral, profunda, branches of the external circumflex and muscular branches, will require ligation in the anterior flap, and the branches of the perforating artery in the posterior flap. The nerves are then shortened, the muscles quilted over the end of the bone and the skin and fascia united by interrupted sutures. Instead of cutting the flaps from without inwards, the limb may be transfixed at the sawline and just in front of the bone, with a long knife, and the anterior flap cut from within outwards. The knife is then entered and made to emerge at the same point as in the previous incision, but passes behind the bone, when the posterior flap is cut from within outwards and backwards.

In place of long anterior and short posterior flaps, the anterior flap may be made short and the posterior long, or the flaps may be made equal in length.

AMPUTATION OF THE THIGH JUST BELOW THE TROCHANTERS BY THE EXTERNAL OVAL METHOD.

(THE HEMORRHAGE IS CONTROLLED BY WYETH'S METHOD.)

The limb is adducted and rotated in.

An incision is commenced over the prominence of the great trochanter and is carried directly downwards on the outside of the limb for about four inches. From this point the lines of the incision diverge, one passing over the anterior surface, the other over the posterior surface, to meet on the internal surface of the limb, two inches below the lowest part of the perpendicular incision. The flaps, including the skin and fascia, are dissected up for two inches and the perpendicular incision carried down to the bone. A circular incision is then made through the muscles and at the border of the retracted flaps, and the bone cleared to just below the sawline, where a periosteal flap is formed and the bone sawn. The femoral, profunda, internal circumflex and some muscular arteries with their veins will require ligation. The muscles should be quilted by two rows of stitches, and the skin flaps united by interrupted sutures (Fig. 501a).

DISARTICULATION AT THE HIP JOINT.

(CONTROL OF HEMORRHAGE BY WYETH'S METHOD.)

Two steel needles, eight inches long and two-sixteenths of an inch thick are required. The outer needle enters the limb one-fourth of an inch below and just to the inner side of the anterior superior spinous process of the

ilium, and passes transversely through the tissues on the outer side and emerges on the same line, three inches external to its point of entrance. The internal needle enters the tissus one-half inch below Poupart's ligament, a little internal to the femoral vessels, and passes through the adductors to emerge one inch below the tuberosity of the ischium. Strong rubber tubing is then wound four or five times forcibly about the thigh above the pins

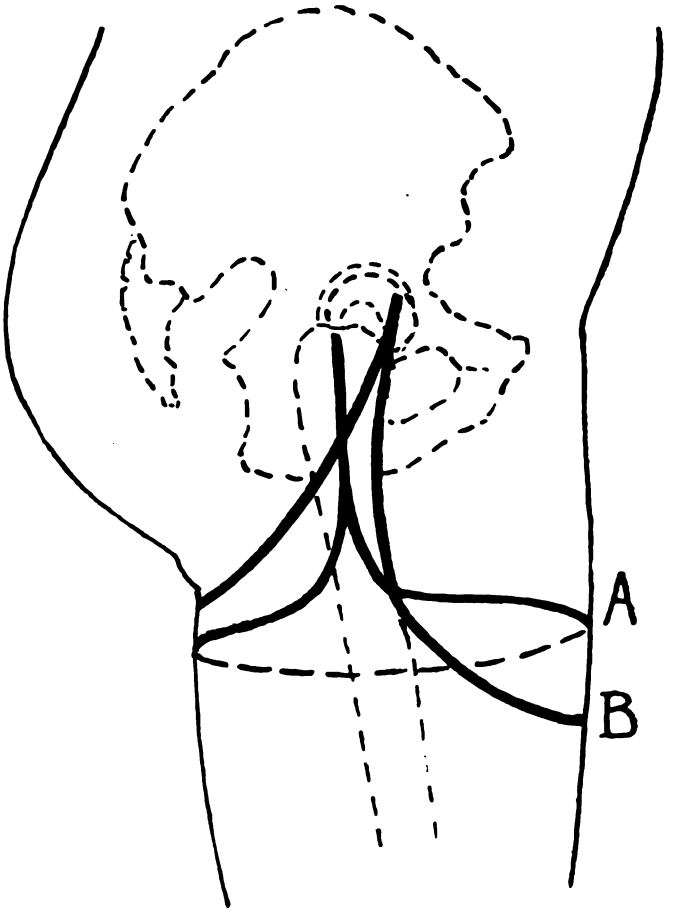


Fig. 501.—Lines of incision in amputation or disarticulation of the hip.

and then knotted. The tubing, if properly applied, completely controls the circulation in the limb.

DISARTICULATION AT THE HIP BY ANTERO-POSTERIOR FLAPS. LISTON'S OPERATION.

The patient should be placed on his back and drawn to the edge of the table, so that the hip projects over the end. The surgeon stands at the outer side of the limb. One assistant supports the patient's body and an-

other surports the limb to be amputated. The well limb is allowed to fall down over the foot of the table. A long knife is made to enter the outer side of the limb just above the top of the great trochanter and transfixes the thigh, grazing the anterior surface of the neck and emerging over the center of the internal surface two inches below the crotch. A flap five inches long is now cut by a sawing motion of the knife and from within outwards. The flap is seized by the assistant, turned upwards, and the iemoral vessels controlled. The knife is now entered and made to emerge

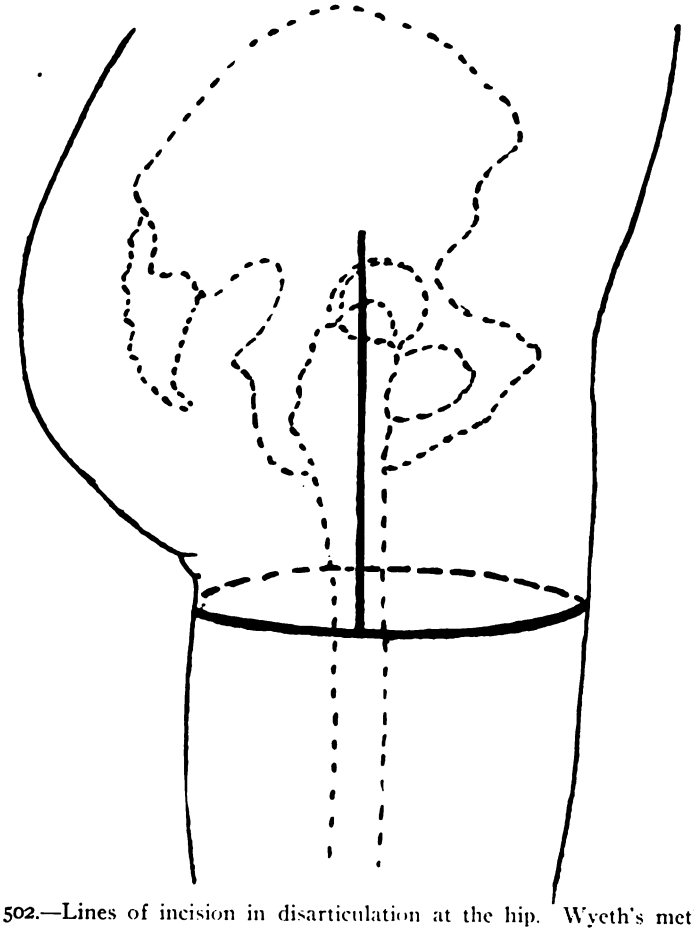


Fig. 502.—Lines of incision in disarticulation at the hip. Wyeth's method.

from the same points as before. It passes behind the bone, when a posterior flap is formed of nearly the same length as the anterior. The muscles attached to the trochanters are now divided close to the bone, the limb adducted, strongly rotated, the capsule, the cotyloid ligament and if possible, the ligamentum teres divided. By rotating the limb strongly outwards and inwards, and freeing the capsule, air is made to enter the joint, when disarticulation can be readily effected and the limb removed. The femoral,

profunda, sciatic and many muscular branches will require ligation. The nerves are then retrenched, muscles quilted and the skin flaps united. Drainage will be required for a few days.

WYETH'S METHOD OF DISARTICULATION AT THE HIP JOINT. (FIG. 501B.)

The patient should be brought down to the foot of the table so that the hip projects. The surgeon stands on the outside of the limb. The patinent's body is supported by an assistant. A second assistant supports the limb to be amputated. The sound limb is allowed to fall over the end of the table. Hemorrhage is controlled by Wyeth's method with steel pins and rubber tubing.

A circular incision is made around the thigh six inches below the center of the rubber tubing. A perpendicular incision is commenced on the outer aspect of the thigh and just below the rubber tourniquet and carried straight down over the great trochanter, to the circular incision. These incisions go through the skin and fascia and are now dissected up for two inches. The perpendicular incision is now carried down to the femur and at the base of the resected flap a circular incision is made which goes to the bone. The femoral and profunda arteries and veins are at once ligated or controlled by forceps. Through the vertical incision the soft parts are separated from the upper portion of the shaft and trochanters, and as close to the bone as possible. The soft tissues are retracted and the capsule divided transversely over its outer aspect. The assistant holding the limb adducts and forcibly rotates it while the surgeon divides the cotyloid ligament posteriorly. This will allow air to enter the acetabular cavity. The ligamentum teres is divided or ruptured and the head of the bone dislocated upwards and backwards. The capsule on the posterior surface, as well as any attached soft tissues, is now divided and the limb removed. The vessels in the anterior flap, if they have not previously been, are now ligated. The vessels in the posterior flap will include the sciatic, terminations of the circumflex and some muscular branches. These are also ligated. The tourniquet is then gradually loosened, and any vessels which bleed ligated. Following the complete arrest of hemorrhage drainage is provided, the flaps if necessary trimmed, the muscles quilted by two or more rows of buried sutures and the skin flaps united by interrupted sutures (Fig. 502).

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